The Journal of the Postal Microscopical Society

Postal Microscopical Society

THE JOURNAL

OF THE

POSTAL MICROSCOPICAL SOCIETY:

A MISCELLANY OF

NATURAL AND MICROSCOPICAL SCIENCE.

EDITED BY

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Honorary Secretary of The Postal Microscopical Society,

ASSISTED BY

SEVERAL MEMBERS OF THE COMMITTEE.

VOL. I.

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Preface.

WITH the issue of this, the fourth, part of our Journal, which completes the first Annual Volume, we heartily congratulate the Members of the Postal Microscopical Society and our Subscribers in general on the success of this undertaking.

Although the publication of such a Journal had been contemplated for some time in the mind of the Editor, still he felt reluctant to enter upon so anxious an undertaking, until early in the present year an esteemed member of the Society, Dr. Measures, of Long Sutton, sent a draft of a proposed Magazine, and by a curious coincidence another arrived on the same day from the editor of a Natural History periodical. Our Committee gave careful attention to both of these schemes, and eventually decided to publish the Journal in its present form.

The Hon. Secretary of the Postal Microscopical Society has undertaken the office of Publisher and Editor. In the duties of the latter office he has received very valuable assistance during the issue of the first three parts from the Rev. J. H. Green (Chairman of the Bath Sub-Committee), to whom he tenders his very sincere thanks,

as well as to those other gentlemen who have kindly volunteered their assistance.

At the suggestion of a great number of our members and subscribers, the quarterly parts of the second volume will be increased in size, and we hope also in the quality and usefulness of the matter contained; at the same time, although a slight increase will be made in the price, it will be supplied at cost price to the members of the Society. To the general public the price will be 1s. 6d. each part.

We have thought it advisable to present our readers with a Map, shewing the general distribution of our Members throughout England. A List of Members is also presented as a Supplement.

Our best thanks are due to those able contributors who have so generously responded to our needs, and to all our friends we adopt the good old English custom in wishing them

"A Merry Christmas and a Happy New Year."

The Journal

OF THE

Postal Microscopical Society.

MARCH, 1882.

To our Readers.

IN adding one more to the already numerous host of weekly, monthly, and quarterly Magazines which are being published on every conceivable subject, it seems desirable to say a few words concerning the reasons which have led to it, and the objects which it is designed to serve.

For some time past a feeling has been growing in the minds of many members of the POSTAL MICROSCOPICAL SOCIETY, that something more was needed beyond the mere circulation of Slides, to bind those members more closely together, scattered as they are over all parts of the British Isles, and with but few opportunities of becoming personally known to one another. A desire was also manifested to utilise in some way the valuable Notes and original Drawings by Mr. Tuffen West, Mr. Hammond, and others, which have hitherto lain buried in disused Note-books; and to put them into such general circulation, that not only the

members of the Society, but others also outside it, might be able to obtain them if desirous of doing so. Various plans were proposed, and these have all had full consideration and discussion: the result is to be seen in the present Journal, which will be published quarterly in the first instance; but if sufficient encouragement is given, and suitable matter provided, it may hereafter be thought advisable to issue it at shorter intervals.

In its pages will be found copious extracts from the Note-books, which are being carefully gone over, and their contents classified as far as possible; choosing and collating what seems of permanent value, but rejecting all that is merely personal or ephemeral. These extracts must necessarily remain somewhat fragmentary in form, but they will be found to contain much interesting detail, and information not easily met with elsewhere.

To these will be added Original Papers by members of the Society and others, on subjects connected with Microscopic study, together with extracts culled from various sources, and recent intelligence as to what is doing among Microscopists generally. Correspondence is invited upon matters relating to the welfare of the Society, or to the general advancement of Science; but everything of a personal or controversial nature will be rigidly excluded. A column will also be devoted to Notices of the Exchange or Sale of Microscopic material and appliances, under conditions therein specified.

By these and other arrangements it is hoped to make the Journal sufficiently interesting to insure a wide circulation among all who are engaged in Microscopic pursuits, both within the Society, and beyond its boundaries. The endeavour will simply be to try and lend a helping hand to isolated workers, and to any others who may desire it; aiming especially at what is useful and practical, while avoiding whatever is merely technical, or too learnedly abstruse. The simple observation of Nature, and the habit of inquiring into her way and modes of working, form the true foundation of every branch of science; it is Lord Bacon

who reminds us that "every phenomenon has its reason, and every effect its cause." By patient searching into these, and by viewing them all as links in the great and wondrous chain which leads us through Nature up to Nature's God, we are using the most effectual means of training our intellectual faculties to their highest development, and providing for ourselves pleasures that are quite unknown by others, to whom Nature is as yet but a sealed book.

It only remains to thank those whose kind co-operation has been given in the preparation of this first number of our Journal, and on whose help reliance is placed for the future. The Committee are anxious to spare no pains in promoting its efficiency and success, but these must necessarily depend in great measure upon the amount of support it receives, and the kind of matter furnished to fill its pages. It is now sent forth, not without some misgivings in this most critical age, but hoping that due allowance may be made for what is a first attempt in an hitherto untried field, and only asking for it a kindly reception, and a fair and unprejudiced judgment as to its merits or demerits. And so this first "Address to our Readers" may fitly close with the familiar lines of Goldsmith:—

> "Blame where you must, be candid where you can;
> And be each critic the *good-natured man.*"

History of the Postal Microscopical Society.

THE issue of this opening number of our Journal seems to afford a good and fitting opportunity for giving a brief *resumé* of the history of the society, of the way in which it originated, and of the ends which its promoters had chiefly in view.

The circumstance which more immediately gave rise to its foundation, was the appearance in "Science-Gossip," during the summer of 1873, of a letter, suggesting that if 12 gentlemen could be found willing to co-operate in forming a little club for the circulation of Microscopic Slides, and notes thereupon, it might lead to a very pleasant and profitable interchange of thought and study. This letter, from an unknown hand, was replied to by our present Hon. Sec., Mr. A. Allen; thereupon a further correspondence and enquiry ensued, when it was soon ascertained, that not 12 only, but 3 times 12, individuals were ready to come forward, and join at once in the proposed scheme. A code of rules, few and simple, was quickly drawn up, and in September of that year the Society came into existence, under the name of the "Postal Micro-Cabinet Club," and with a roll of 36 members. Mr. A. Atkinson, of Brigg,—the writer of the original letter in "Science-Gossip,"—was chosen its first President, and held that office for two years; he was then succeeded by Mr. T. West, who continued to hold it until failing health compelled his resignation in 1879, much to everyone's regret. By that time the club had increased from 36 to over 100 members, its sphere of action and usefulness had greatly enlarged, and it had changed its first title for that of the "Postal Microscopical Society," which it now bears. What more remains to be said about it, may perhaps be most fitly said in the words of Mr. West, as spoken by him in his Presidential Address for the year 1877:—

"As is generally the case with great inventions or discoveries, the possibility of conducting such an important educational work through the post, originated quite independently in the minds of two individuals, and at just the same period of time. These workers were living far apart, entirely unknown to each other; but the time was ripe for the coming event—the nascent thought was brooded upon, its practicability made clear, and we had our birth. Need I say that the honoured name of one was Alfred Atkinson! on whom, from slight priority of utterance to his

thought, was conferred (as well beseemed) the dignity of first President to the Society? The name of the other, Alfred Allen! whom we are all proud to welcome this evening, still so ably filling the arduous and responsible post for which he then volunteered—that of Honorary Secretary.

"The design of the Society is specially to afford, to dwellers in remote parts of the country, by means of postal facilities, the advantages derivable from interchange of thought on such subjects of common interest as may be elucidated by the microscope. This is to be done by passing slides from one member to another in regulated course. And how vast a field lies before us! There is not a subject you can approach at the present day, be it mineral, vegetable, or animal, but it has its microscopic side, needing the application of this magic tube to elucidate all its bearings. Years ago, Professor Owen, speaking of Geology, said that the student of this science, to be successful, must possess a knowledge of Chemistry; of Meteorology and Mineralogy; of Botany, Zoology, and General Physics:—in effect, must have a good acquaintance with the general circle of the Sciences. What a task indeed! And now must be placed in this enumeration, all the knowledge which has been gained by the microscope in each of these various departments.

"That a considerable measure of success has attended our efforts will not be denied. The continued increase in our numbers testifies in one way to the fact; showing clearly that by the establishment of this Society, a want which many had felt is being supplied. Were it desirable it would be an easy matter greatly to add to those numbers. But though it is freely admitted there would be some gains to be reaped from such a course, I confess to having grave doubts as to mere numbers being an unalloyed advantage to us. A small, compact army of well-disciplined soldiers is both more easily handled, and capable of more execution, than one whose very size introduces an element of weakness: it then becomes unwieldly in its strength. The difficulties of working through the post with large numbers of members appear to me to be very great.

"Should it be deemed desirable to limit our numbers in order to increase our effectiveness, the question presents itself for solution, —Who are those we should most seek to attract?

"Workers in isolated spots should have our first consideration. It was for their benefit especially that the Society was formed; it is on such that the arrival of a Box of our Slides, with its accompanying Book of Notes and Drawings, confers the greatest boon. None but those who have experienced it, can fully realise the state of stagnation into which even an active mind may sink, with no

fellow-worker at hand; none with whom to communicate on subjects enlightening and elevating, such as these.

"Nor is the state of matters much more hopeful with the dweller in or near a large manufacturing town, the inhabitants of which are too much engrossed with the pursuit of material wealth to cultivate the God-like portion of their being, the mind! To isolated dwellers in such a community, possessed of higher tastes and feelings, our Society may be made a priceless boon; one of the means of retaining faith in God, and their fellow-men; which might otherwise be trodden under foot of mammon, or die out from sheer inanition.

"Then I think that our Society may be the means of linking together in happy and profitable union, other like bodies having kindred aims. That we might become the cement whereby other local leaders of scientific thought in their various districts—say the President, Secretary, and one or two others of the most active members, being also members with us—might keep up, and through the pleasant intercourse thus created, augment a common interest in each other's well-being.

"Nor, though mentioned here last, is it intended in any sense to forget, or treat lightly, the claims on our regard of the fairer, the brighter sex. I have had some experience of Microscopic Soirées—my first dating more than thirty years ago, the life-time of a generation—and have ever taken note that the most delighted observers, the most eager questioners and listeners, on such occasions, were the ladies! It is a trite saying, that man has to work out his conclusions, whilst woman sees them intuitively. I plead for the admission to our Society of Ladies; on equal terms, with equal rights and privileges. We cannot but be gainers by the sharpness of their insight into structure; the neatness, tidiness, ingenuity in the modes of mounting, which would soon follow after a little practice by them. In cases where the experiment has been fairly tried it has proved a complete success.

"With regard now to the future work of our Society. I consider one great advantage possessed by our members, to a greater degree than in any other Society with whose workings I am acquainted, consists in the very large amount of *general* knowledge to be gained by careful study of the various slides which come before us, instead of restricting themselves too closely to one subject. If due care be taken to profit by this, plenty of openings for special work in many different directions cannot fail to present themselves. Mosses have scarcely been brought before us at all; Fern-structures in only a desultory way; Seeds and Seed-structures, Algæ and Desmids; Marine organisms of various kinds; the

innumerable form of Fungi;—all present a very wide field indeed. The smaller Crustacea appear to have engaged little attention from our members. Amongst Insects, the Diptera alone would furnish an enormous field for work. How few of the 'Saws of Saw-flies' have yet been satisfactorily identified! And though so many forms are to be met with among the Miscellanea of Cabinets, this is as nothing compared with what remains to be done at them. The Acari are numerous;—practically inexhaustible, and most urgently require such work as our members might profitably take up.

"And so we might go on. Let but a kindly feeling prevail amongst our members towards one another, a readiness to help for the love of science, and present difficulties in the real study of the minuter forms of life will easily be overcome and vanish."

Numerical Aperture.

BY THE HON. J. G. P. VEREKER.

AMONG English Text Books on the Microscope, the only one, as far as I know, which defines what is now known as "Numerical Aperture" is the last edition of Carpenter on the Microscope: although the subject has been fully debated by the "Royal Microscopical Society," and described in its Journal.

As, however, many members of the "Postal Microscopical Society" may not have followed these discussions, it may prove of interest to them that I should give an account of what this term means. I send, therefore, an article on it, both for the above reason, and also because a clear appreciation of it is most important.

The ideas of microscopists have lately undergone considerable development, owing to the investigations of Professor Abbe, which have led him to define the laws of aplanatic combinations, and also to put forth his diffraction theory of microscopic vision; and these investigations may be considered amongst the most important advances in modern optics.

Owing to his theories, the older plan of measuring the aperture of objectives by mere angular magnitude has been found to be unsatisfactory; and probably the aperture will in future be very generally expressed numerically.

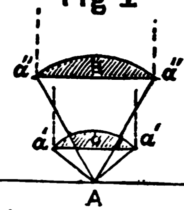
It is necessary for a clear understanding of this subject to approach it *ab initio*, laying aside all preconceived notions, and bringing in the abstruser laws of optics.

For this purpose we must first realise what is meant by *aperture* :—

The word aperture means "an opening," and in optical instruments ought to be measured by the greatest amount of light from the same area, which can traverse the system, the intensity of the illumination remaining constant. In the case of the microscope, with which we are at present dealing, this is evidently dependent on the objective.

Now, if in Fig. I., A is a luminous point, placed at the focus of the lenses B or C, acting independently of each other, and giving out rays of light, Aa′, Aa″, in every direction,—the lens C, though of less diameter, has evidently a larger aperture, that is, admits more light than B. On the other hand, C is of shorter focus than B. This shows that *focal length* is an element in the true calculation of aperture.

Fig I



In a compound system, however constructed, as in Fig. II., where two lenses are represented in combination, viz., BF and C, the amount of light which passes through the system from the point A at its focus, is represented by the amount of light included between BD and FE, the limiting rays emerging from the back lens; as this back lens cannot transmit more light than it receives, for which it is dependent on the front lens C, it follows that in any system of lenses, the system ought to be treated as a whole, and the aperture measured by the emerging beam. Any method which does not do this is liable to error; and in the following arguments the objective is treated as if it were a single lens.

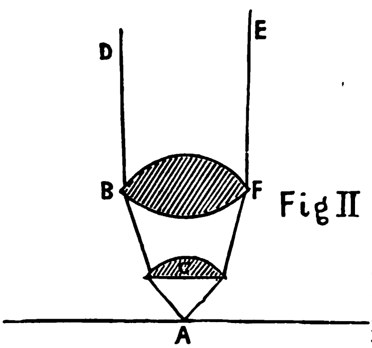
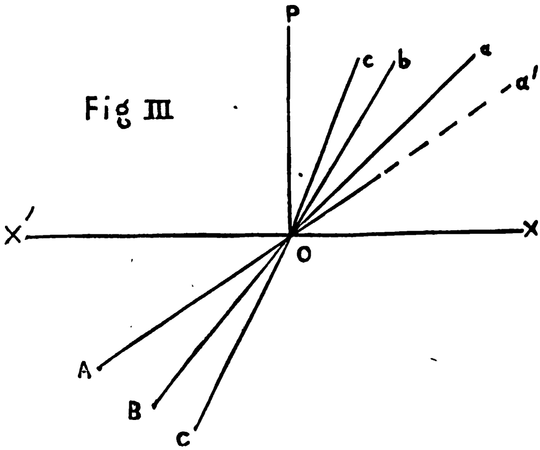


Fig II

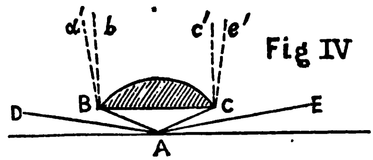
On the undulatory theory, a wave of light passing from a rarer to a denser medium is retarded, owing to the free vibrations of the luminous ether being, so to say, "clogged," thus causing the phenomenon of refraction. For example, if in Fig. III.,



XX' represent the limiting surface between the two media, the oblique rays AO, BO, CO, instead of passing through in a straight line, like AOa', are squeezed together, and brought nearer the normal OP; and,—*vice versâ*,—rays passing out of a dense medium into a rarer one are expanded. The effect of this is that in the dense medium the waves of light are shortened, and a given area in a dense medium contains more light-waves than the same area in a rare one.

In applying this to our present question, it is to be remembered that the medium into which the pencil emerges is always air.

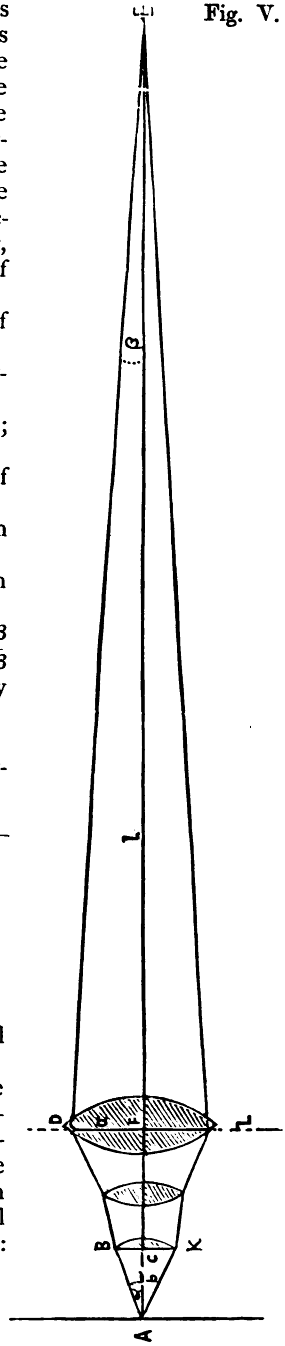
If, in Fig. IV., BC represents a lens, and A a luminous point placed at its focus; then, if there is air between the lens and the object, the cone BAC will represent the extreme amount of light which can pass through the lens; if, on the other hand, a denser medium than air be interposed, the cone, BAC, will include, for the above reasons, a larger amount of light-waves, represented in air by the larger cone DAE: consequently, the angle of the emergent pencil is increased, and the aperture enlarged.



The *density of the medium*, between the objective and the object, must therefore be taken into account in estimating the aperture; although it in no way alters the *angular* magnitude of the entering pencil of light.

The next question is, how are we to get an expression for aperture which will enable us to compare lenses with reference to each other?

Fig. V.



Take any aplanatic system, as represented in Fig. V., A being, as before, an object at its focus, the image of which is projected to the conjugate focus at E. As we are only comparing the relative emergence of light, not the absolute quantity, we can consider the case of an infinitely thin pencil, represented by the plane of the paper, and also consider only the case of the semi-diameter of the pencil.

Let DEL represent the plane of emergence.

DF = a = the amount of emergent light;

$\angle$BAC = α ; $<$ DEF = β; FE = l = constant * ;

AC = b = the focal length of the objective;

n = index of refraction of medium in front of the objective;

m = index of refraction of medium behind the objective;

Then $a = l \tan\beta = l \dfrac{\sin\beta}{\cos\beta}$

(as β is very small, $\cos\beta$ = nearly to 1)

$$\therefore a = l \sin\beta \quad (1)$$

By the laws of aplanatic convergence

$$\frac{n \sin\alpha}{m \sin\beta} = \text{magnifying power} = \frac{l}{b}$$

$$m = 1 \quad \text{for air}$$

$$\therefore l \sin\beta = b\, n \sin\alpha \quad (2)$$

Substituting value of $l \sin\beta$ (1)

$$a = bn \sin\alpha$$

$$\frac{a}{b} = n \sin\alpha$$

Or the ratio of "aperture" to "focal length" is expressed by "*n sin a.*"

This expression is known as the "numerical aperture" of an objective, α being the semi-angle of aperture as usually given, and n the refractive index of the medium in front of the objective. The principal values of n in microscope work are:

* This varies with the length of tube for which the lens is corrected.

Air = 1; water = 1.33; oil * or crown glass = 1.52.

It will be seen that the total amount of light admitted is proportional to $(n \sin a)^2$.

There is another corollary from this proof, viz., that if the wave-length of light is taken as 1-50,000 inch—that is, about the middle of the green in the spectrum—the theoretical limit of resolving power of objectives, in number of lines to the inch, is found by multiplying the numerical aperture by 100,000.

From the above arguments it follows, that to get a true idea of the actual capacity of a lens to transmit light, the older plan of measuring the angle by degrees is unsatisfactory, even if the objective in question is a dry one, and, in comparing dry and immersion lenses, is misleading; for an immersion objective has really a larger aperture than a dry one of the same focus and *angular* aperture.

Also it is seen, that if the extreme limit of angular aperture, viz.. 180°, is taken, the amount of light received varies in air and oil, as 2 : 3.

This, on consideration, shows that, owing to the reduction of the length of light-waves in a medium like oil, smaller objects can be seen than could be delineated by a dry lens of even *extreme* theoretical limit. This is practically proved, both by experience, and by the fact that immersion objectives can and do utilise larger back lenses than dry objectives,

The question of the value of wide-angle lenses is entirely distinct from this paper, which aims solely at showing how to compare apertures truly.

As an example, take an 1/8-inch of 100° immersion (water), one of 120° dry, and 140° dry.

The numerical aperture of these are as follows:—

(100° water-immersion) . . . 1,024; (120° dry) . . . 0,866;
(140° dry) . . . 0,940.

It is seen by this that the immersion lens, though it has the smallest *angular*, has really the *largest aperture:* and the lenses resolve, theoretically, in lines to the inch, as follows:—

(100° water immersion) . . . 102,400 lines;
(120° dry) 86,600 lines; (140° dry) 94,000 lines.

It will also be seen, that no dry lens can, with the wave-length of 1-50,000 inch, resolve, theoretically, a greater number of lines than 100,000 to the inch,† whereas the homogeneous oil-immersion objective, of refractive index 1.52, can resolve 152,000 lines to the inch.

This is taking the lenses at their theoretical limit of 180° aperture.

* This is a homogeneous oil of the same refractive and dispersive index as *crown glass,* of which lens fronts are now made.

† Amphipleura pellucida contains about 90,000 lines to the inch.

I trust this article will give the members a clear appreciation of what aperture means, and the mode of expressing it numerically; also what increase of resolving power may be expected to be obtained from an increased aperture.

On the Microscopical Examination of Chlorophyll, Inulin, and Protein-Crystals.

TRANSLATED FROM THE GERMAN OF DR. LEOPOLD DIPPELL.

BY CHAS. VANCE SMITH.

CHLOROPHYLL, the green colouring matter of plants, consists, strictly speaking, of a formless substance, and only takes the shape of grains, when it serves to impregnate other constituents of the contents of the vegetable cell, which are then termed Chlorophyll-bodies. It never forms the contents of minute vesicles, as has been asserted on insufficient evidence. To ascertain its amorphous character, it is only necessary to place a suitable section in either alcohol or ether, which will at once dissolve out the Chlorophyll, leaving the base, which it has served to colour, behind unchanged.

In the case of many plants—for example, the cells of *Draparnaldia*, *Spirogyra*, *Zygnema*, *Closterium*, and other algæ, and also in the fronds of *Anthoceros*—the Chlorophyll is distributed indiscriminately through the general protoplasm, and may, for distinction sake, be spoken of as amorphous. In by far the greater number of plants, however, it is not thus generally distributed, but is confined to certain granular bodies imbedded in the protoplasm, and has the appearance of being itself granular.

The matter of which these Chlorophyll bodies is composed is not the same in all plants, being, in fact, of two kinds. In the first, they consist of a nitrogenous substance, probably a hardened portion of the protoplasm; since, on withdrawing the colouring matter by means of alcohol or ether, and applying the usual chemical tests, an unmistakeable albuminous action is evident. Such Chlorophyll-grains are found in the fully-developed leaves

of the Tulip, of *Ilex aquifolium*, *Sedum acre*, and *Sedum telephium*. As a rule, their shape resembles that of a flattened lentil, and they vary in size from ·0075 to ·009 mm.

Chlorophyll-bodies of the second kind are composed of one or more starch-grains, over which the Chlorophyll, colouring a certain amount of protoplasm, forms a covering of varying thickness; the presence of the starch being easily recognised by its characteristic blue colour, on the application of iodine solution, especially if the Chlorophyll has first been removed by alcohol or ether. In shape Chlorophyll-grains of this description vary greatly, being round, oval, or even rod-like; and their size is from about ·0075 to ·019 mm. Of the plants in which they alone are found may be mentioned the epidermis of the antheridia of Mosses, the leaves of Mosses and Liverworts, and of Mistletoe and *Hoya carnosa*. When the outer layers of leaves and green stems contain only Chlorophyll-grains of the nitrogenous kind, starch-bearing grains are also always present in the more deeply-buried layers, and indeed they appear to possess a very general distribution among Chlorophyll-bearing plants.

The earliest stages of the development of the starch-grains within the Chlorophyll cannot be observed under the microscope. What may, however, be seen is the following:—Within the hitherto apparently homogeneous Chlorophyll-grain, one or more minute granules make their appearance, and gradually increase in size, dilating the grain containing them. The layer of protoplasmic matter covering the starch thus becomes thinner and thinner, and at length disappears altogether, setting the starch-grains free. It need hardly be said that a high magnifying power and very carefully-prepared sections are needed thus to watch the development of the starch.

Inulin was at first believed to be peculiar to the *Compositæ*, but is now known to be present in plants belonging to other orders as well. It is oftener found in the roots than in the stems, and may be looked for in such plants as the dandelion, the sunflower, or the dahlia. In living cells it exists only in solution, but its presence may be rendered evident by placing a section from the root of one of the above plants in alcohol, when the Inulin will be precipitated in the form of minute granules. If the section be left in alcohol for five or ten minutes, these granules will unite into larger bodies, which under water appear to have cracks running radially through them; and sometimes, especially after the addition of nitric acid, to be composed of distinct layers. The finest crystals of Inulin are, however, obtained by leaving larger pieces of suitable roots in alcohol or glycerine for a period of several weeks, and then cutting sections of only moderate thinness.

For the examination of the Protein-Crystals or Crystalloids of the tuber of the potato, the skin of the tuber should first be removed and a very thin section then taken parallel to the surface. The Crystalloids are not present in all potato-tubers, nor are they equally developed in all those in which they exist; but in cells containing them, they may generally be found either embedded in the protoplasm, often in the immediate neighbourhood of the nucleus, or in contact with the primordial utricle. They are also to be found in many oily seeds, such as the Brazil nut, the Castor-oil seed, the Hazel nut, etc., where they lie embedded among the other granular contents of the cells, and may be brought into view by cutting thin sections through the endosperm.

On Tubifex Rivulorum.

By A. Hammond, F.L.S.

Plate 1.

THE following observations on the structure of this interesting little worm are the result of such study of the subject as the author has been able to make during the short period of about eight weeks. They, therefore, must not be taken as either exhausting the subject, or as offering any new information thereupon. To tell, indeed, all that might be said upon it would require far more space than can probably be spared for it in the pages of our newly-started Journal.

A reddish blush, spread over the surface of the mud at the margin of a slowly-moving stream, is a sure indication of the presence of Tubifex; touch the surface, however lightly, with the end of your stick, and the blush disappears for some inches around it, showing the extreme sensibility of the sense of touch in these animals, as in others of their class—a sensibility, indeed, which supplies the place of all other organs of perception. The name "Tubifex" was applied to these worms by Lamark, from the habit they are said to have of constructing a muddy or sandy tube for their dwelling, in which they reside head downwards, the tail projecting from the orifice, and waving to and fro in the water for the purpose of respiration. It is somewhat singular, that I have frequently obtained a plentiful supply of worms without a single fragment of the tubes; at other times, I have obtained the tubes, but in small numbers, totally disproportionate to those of the worms; and on such occasions, my finding of them has been associated with two curious circumstances. First, that the tubes

obtained seemed to be such as I had noticed, at the time of gathering, lying in considerable numbers prone on the surface of the mud, instead of being, as usual, buried therein, and presenting only the orifice; and secondly, that, with one exception, they were either devoid of their proper tenants, or else occupied by an intruder in the shape of a "figure-of-eight," or blood-worm, as they are familiarly called—the larva of *Chironomus plumosus*. The tubes thus found are flaccid, totally devoid of rigidity, yet having sufficient coherence to render it difficult to understand how, on the many occasions in which I have failed to find them in my collecting-bottle all trace of them should have been destroyed in the act of removal.* The worms appear to be confined to very narrow limits as to depth; they are frequently covered with the merest film of water, and never (so far as my observation extends) is the red blush which indicates their presence found at a greater depth than two or three inches. On this account I placed them on reaching home, in a saucer, with about half-an-inch of water to cover them, and have kept them in this condition for three or four weeks. I have never seen any attempt on their part to reconstruct their tubes. They lay their eggs, however, plentifully at this season of the year (February); and these are contained in capsules, holding from one or two to six or eight. The capsules, which are nearly white and about the size of a pin's head, begin to strew the surface of the mud in the saucer in the course of a day or two. After the lapse of some days, however, the worms do not thrive, numbers of them being found in a fragmentary condition; but whether this is the result of a suicidal tendency, owing to unnatural conditions, or is the initial stage of the process of reproduction by fission, which is stated by many authors to occur, I am unable at present to say. From the abundant deposition of eggs, it is evident that numbers of them must have completed the usual cycle of existence, and their decease on that account might be expected; but though the fragments appear lethargic and unhealthy, and the vascular system has in many cases lost its colour, yet vitality is evidently not extinguished; and what is more, the wound frequently seems to be healed by the formation over it of a new skin. I have not as yet, however, seen anything like the formation of a new head or tail.†

Various authors have at different times described the anatomy and habits of *Tubifex*. The most important treatises, how-

* Since writing the above, I have had reason to doubt whether the tubes above described are the work of the annelid or of the larva. If the latter, I have never seen as yet a trace of the tubes from which the worm takes it name.

† It should be noted that Dr. Williams strenuously denies reproduction by fission in the annelida. See Report of the British Association for 1851, p. 247.

ever, on the subject are those of Bonnet,* Jules d'Udekem,† and Edouard Claparede,‡ on the Continent; whilst at home we have observations by W. C. McIntosh || and Ray Lankester.§ Bonnet's work deals with the result of cutting the worm in half. Jules d'Udekem gives us a most elaborate and careful monograph, illustrated with four beautifully executed plates; and he was ably followed by Claparede, whose work refers to a closely allied species, *Tubifex Bonneti.* He points out several errors which d'Udekem had made, at the same time fully acknowledging the general excellence of his work. The works of the two last-named authors are devoted to special points on which they differed from, or made advances on, their predecessors.

The most abundant worm in Thames mud is *Tubifex rivulorum.* Two other worms are, however, very abundant, living inextricably mixed with it in masses: one is *Limnodrilus Udekemianus* of Claparede, distinguished by the absence of the capillary setæ of the former, and by the unusual thickness of the integument; and the other, *Tubifex umbellifer* of Lankester, which has the dorsal setæ of the first ten segments webbed (see Pl. 1, Fig. 1). My own observations have been confined to *T. rivulorum.*

The worm (Fig. 7) is about an inch or a little more in length, and from its small size, and the transparency of the integument, forms a good subject for examination in the living state with low powers of the microscope: the chief features of annelidan organisation revealed thereby being the perivisceral cavity, with its contained perivisceral fluid and corpuscles (Fig. 10),—the system of closed vessels containing a coloured non-corpusculated circulating fluid, regarded by some authors as a true blood system, and by others as a pseudo-hæmal system analagous to the water-vascular system of the Scolecida, Rotifera, etc., the nature of which is respiratory (Figs. 9 and 10);—and lastly, the intestine with its covering of glandular hepatic cells (Fig. 10). The reproductive organs, extending from the 9th to the 15th segment, are only indicated, on a casual glance, by the superior size of this part of the body in mature specimens, and require

* Œuvres d'histoire naturelle de C. Bonnet, Amsterdam, tom. I., 1780.

† Histoire naturelle du Tubifex des ruisseaux: Memoires couronnés de l'Academie des Sciences, de Belgique. Brussels, 1855.

‡ Recherches Anatomiques sur les Oligochètes, par Ed. Claparede, Memoires de la Sociéte de Physique de Genève, tome XVI., 1861.

|| On some points in the structure of Tubifex, by W. C. McIntosh, M.D. Transactions Edinburgh Society, Vol. 26, 1870.

§ Observations on the Organization of Oligochætous Annelids, by Ray Lankester: Annals. Nat. Hist., 1871; also, on the Spermataphores of Tubifex, Quar. Journ. Micro. Science, 1871, p. 180.

much searching to make their structure evident. The number of segments varies much; I have counted in some specimens from 60 to 80 of them. Each segment is separated from those adjoining by a muscular septum, closely constricting the intestine at these points. It may be somewhat difficult for an uninitiated observer to distinguish the head of the worm from its tail; but the position of the setæ, directed backwards as the worm advances, will show that the bluntly-pointed termination of the body is the head, while the tail tapers away gradually and then ends off abruptly truncated.

The setæ, with which every segment of the body, except the head is furnished, are of two kinds—the long capillary setæ, which are confined to the dorsal surface; and the hooked setæ, which are common to both surfaces. They are found in bundles, of which each segment possesses one pair containing capillary, and two pairs containing hooked setæ. The latter are of the forked shape, shown in Fig. 2. The number of setæ in each bundle varies somewhat, the capillary setæ being usually two, rarely three or four,—and the hooked varying from three to seven. The hooked setæ are placed in pouches or invaginations of the epidermis, to the bottom of which radiating muscular bands are attached, by which their movements are effected (see Fig. 3).

The integument is described by d'Udekem, as consisting of a delicate epidermis, and of a chorion intimately united to the muscular layer. The latter is divided into six longitudinal bands, separated by as many furrows, as shown in the ideal transverse section (Fig. 4). Upon these furrows are situated the bristle-sacs, and into them the perivisceral cavity extends. This perivisceral cavity occupies the whole of the large space which everywhere intervenes between the muscular layer and the intestine. It is lined throughout with a cellular membrane, continuous, according to Ray Lankester,* with the glandular covering of the intestine, of which we shall presently speak; so that it may be described as a double bag through which the intestine passes. On this account it has been likened, by Dr. Williams,† to the peritoneal cavity of the human body, and its contained fluid has received from him the designation of the peritoneal fluid, or the chylaqueous fluid of the peritoneal cavity. Between every two segments it is greatly constricted by the muscular septum or partition already referred to. The fluid with which this cavity is filled is a highly coagulable and vital one. The coagulating principle consists of fibrine, and the great bulk of the fluid portion is composed of sea-water. Mechanically and physiologically, as Dr.

* Observations on the Organization of Oligochætous Annelids, Annals of Natural History, 1871.

† Report Brit. Assn., 1851.

Williams says, it is essential to the maintenance of the life of the annelid:—mechanically, by preventing contact between the intestine and the integument, and by furnishing the fulcrum on which all muscular action is based; physiologically, by furnishing the pabulum out of which the true blood is being perpetually reinforced. It holds organic corpuscules in suspension, which perform irregular to-and-fro oscillations, under the agency of the muscular contractions of the intestine and integument, passing from segment to segment, either between the internal borders of the septa and the intestine, or, as Claparède states, through orifices provided in the septa themselves. The character of the corpuscules varies, according to my own observations, considerably; some being opaque and others transparent, some circular and others very much elongated (see Fig. 5). This variation may be connected with the fact, asserted by Lankester, that the cellular membrane (endothelium) of the perivisceral cavity casts off its cells into the perivisceral fluid. I must not omit to mention that Dr. Williams regards the perivisceral fluid as physiologically allied to the chyle of the lower animals,—that, in fact, it presents the same relation to the contents of the proper blood-system of vessels that the chyle of the higher animals does to the true blood in them.

The blood proper, as it is termed by Dr. Williams, is in this annelid a red,* non-corpusculated fluid, circulating in a system of closed vessels, the main trunks of which are more or less intimately united to the intestine, but send out branches into the peripheral portions of the body (Fig. 9). A large dorsal vessel, thrown into many sinuosities, carries the blood from the tail towards the head of the animal, where it bifurcates, and subdivides into numerous small branches, which, reuniting, go to form the feeders of the main ventral vessel, by which the blood is carried back again towards the tail, where it finds its way again into the dorsal. "† In each segment two great branches pass off from the dorsal and ventral vessels respectively. Towards the posterior border a large trunk (the perivisceral) springs on each side from the dorsal, and proceeding outward towards the body-wall divides into numerous capillary branches, which again unite to form a trunk nearly as large as the original, that on each side enters the ventral vessel. The coils are especially distinct towards the posterior part of the body. About the middle of each segment, again, the ventral vessel on each side gives off a branch, which passes upward round the intestine; but whether it terminates by anastomosing with its fellow of the opposite side, or by

* In some of the Annelida this fluid is green.

† See McIntosh on Structure of Tubifex. Trans. Edin. Soc., vol. 26.

joining the dorsal, could not be determined." The foregoing account of Dr. McIntosh is in the main confirmatory of the observations of Claparède, some additions being made thereto. It will be observed that the "perivisceral branches" proceed toward the body-wall, floating, as they do, freely in the perivisceral cavity; while the others, which proceed from the ventral main trunk, tightly enclose the intestine; they are called by Claparède the "intestinal branches." The periviscerals of the eighth segment appear to be slightly more swollen than the others, and have been described as hearts,—a pulsating movement being observed in them. The pulsations, however, do not appear to be confined to those of the eighth segment, but extend, according to Claparède, to the tenth, eleventh, and twelfth. I have myself seen portions of these vessels suddenly contract and assume a puckered aspect, the contained red fluid being completely, for the moment, expelled.

It may be observed that there are no special respiratory organs visible in *Tubifex;* and the question may be asked, in the first place, "How is the respiratory process carried on?" and in the next, "Which of the two fluids in question is the subject of that process?" The thinness of the integument would in any case offer great facility for the aëration of the blood, and especially in the intestine, where a constant access of fresh water is maintained by ciliary action; but the true answer to the question would seem to be involved in considerable difficulty, from the opposite points of view in which the relations of the two fluids are regarded; for while Dr. Williams, who regards the circulating fluid as true blood, thinks that it receives its supply of oxygen in *great part* through the intermediate agency of the perivisceral fluid by which its vessels are bathed,—Dr. Carpenter, on the other hand, regarding the perivisceral fluid as the true blood, conceives that the coils of the "vascular system" floating therein are destined to convey to *it* the aërating influence received by the red fluid in its circuit.

We must now notice the coiled vessels, which have received the name of segmental organs. They are two in number on each segment (Fig. 10), and consist of long, twisted, vibratile canals, with an external and an internal orifice. They are provided with an external and an internal tunic, the former of which is described by d'Udekem as elevated into pouches* (see Fig. 6), and the latter is provided with cilia, which cause a current to flow from the interior towards the exterior. The external orifice is situated a

* I am doubtful as to the correctness of this observation. In *Limnodrilus Hoffmeisteri*, Claparède describes the organs of the 7th and 8th segments as covered with a mass of pyriform glandular cells (see Fig. 11), and I have been able to verify his statement. Possibly, d'Udekem's pouches are also cells.

little in advance of the ventral setæ; and the internal orifice, after traversing the system, opens into the segment preceding that in which its convolutions and external orifice lie, where it presents a crown of cilia. The normal function of these organs is believed by d'Udekem and Claparède to be excretory, and not respiratory, as has been supposed by others; and this opinion seems to be borne out by the fact that the ciliary current is always from within, outwards. In certain segments of the worm, however, the segmental organs are specialised to provide efferent ducts, etc., for the reproductive system. Where this is the case, they are large and very apparent; but in general they are rather difficult to distinguish amid the contents of the perivisceral cavity.

The alimentary canal consists of a mouth, pharynx, œsophagus, and intestine. There is no muscular crop or gizzard, as in the earth-worm. The mouth usually shows as a transverse line on the lower surface of the cephalic segment. It opens into a more or less globular pharynx, occupying two or three segments of the body, and provided with a muscular coating. The pharynx is capable of being projected from the mouth, and again withdrawn. The œsophagus occupies the fourth and fifth segments, and is succeeded by the intestine. As far as this point, the alimentary canal is devoid of colour. The intestine is considerably larger than the œsophagus, and extends to the termination of the body. It has an inner mucous membrane, covered with vibratile epithelium, the cilia being especially visible near the anus, and an outer muscular coat, by which the peristaltic movements are effected. This coat, however, requires the addition of acetic acid to render it visible. It is covered throughout its length with a cellular investment (Figs. 8 and 10)—at least, such is the account generally given of it; but Lankester points out, what appears extremely probable, that this cellular covering is but the internal parietes of the perivisceral cavity. A glandular function is attributed to these cells, and it is said that they secrete a fluid into the intestine analogous to the bile of the higher animals. Claparède, however, doubts the hepatic character attributed to them, pointing out that they cover the dorsal vessel as well as the intestine; and he thinks they may pour their secretion into the perivisceral cavity. Lankester says:—"The whole of the endothelium" (*i.e.*, the whole of the wall of the perivisceral cavity, including, as he views it, the glandular covering in question) "sheds its cells into that cavity. The cells are filled with brownish granules, giving a colour to the intestinal tract that is wholly wanting to the pharynx and œsophagus."

Before quitting our subject for the present, we may say that d'Udekem describes the nervous system as consisting of two closely united cords, bifurcating to form the œsophageal ring. From the brain, two pairs of nerves were thought to arise. The

nervous cords are difficult to make out, and I have only succeeded in catching occasional glimpses of them.

The reproductive organs present a complicated structure, and many points of very great interest; but space is wanting here for their elucidation, and they must be reserved for, perhaps, another opportunity. I trust that the foregoing remarks may enable some of our members to take an interest in this despised little worm, within whose tiny compass so many lessons of physiological importance lie hid.

EXPLANATION OF PLATE I.

Fig. 1.—Webbed seta of Tubifex umbellifer, extremity only.

,, 2.—Hooked setæ of Tubifex rivulorum.

,, 3.—Bristle-sacs with muscles.

,, 4.—Ideal transverse section of worm, after Claparède, showing—*a*, the integument; *b*, the layer of circular muscular fibres; *cc*, the six bands of longitudinal muscles; *ff*, the furrows between these bands into which the perivisceral cavity extends; *p*, the perivisceral cavity with its corpuscules; *d*, the dorsal vessel; *v*, the ventral vessel; *g*, the glandular hepatic cells of the intestine; *e*, its inner vibratile epithelium.

,, 5.—Corpuscules of perivisceral fluid.

,, 6.—Portion of segmental organ, after d'Udekem, showing pouches.

,, 7.—Tubifex rivulorum, slightly magnified.

,, 8.—Glandular hepatic cells of intestine.

,, 9.—Anterior segment of Tubifex rivulorum, after McIntosh, showing arrangement of blood-vessels: *d*, the dorsal; *v*, the ventral vessel; *pp*, the perivisceral; *ii.*, the intestinal branches.

,, 10.—Three segments of Tubifex rivulorum further enlarged, showing the intestine constricted by the segmental septa: *d*, the dorsal, and *v*, the ventral vessels. In the first segment the integument and ventral hooked setæ, *st*, are shown; in the second, the segmental organs, *s*, with their orifices, *o*; and in the third, the perivisceral corpuscules, *cp*.

,, 11.—Portion of segmental organ from eighth segment of Limnodrilus Hoffmeisteri covered with pyriform glandular cells.

On Diatoms.

By Thomas Partridge, M.K.Q.C.P.

IT is not my intention in this paper to offer any description of these curious structures, their mode of growth, development, or peculiarities, all of which have been often explained already; but merely to give a few disconnected and brief notes and ideas that have been brought to my notice lately.

These interesting and peculiar organisms are found nearly everywhere, and though usually invisible to the naked eye, they exist in myriads, and, as Pritchard in his "Infusoria," says (p. 305), "*Play a more important part in forming the earth's crust than even the gigantic Saurians of the past.*"

Diatoms are found in the Eocene, Miocene, Pliocene, and Chalk formations, and even the Oolitic are not *without traces* of them. A deposit of diatomaceous earth was found 400 miles long by 120 wide in Victoria Land; and the town of Richmond, Virginia, is built on a bed of diatoms 18 feet deep and unlimited in extent. The deposits at the bottom of lakes are composed of this material, as may easily be seen on examination of the mud. The polishing slate of Bohemia, "Turkey stone" and "Rotten stone," are composed chiefly of diatoms, and in our own country, North Wales, Ireland, and Scotland, large deposits are found; while in Sweden and Norway, the Bergh Mehl, or Mountain-Flour, is composed of diatomaceous earth, which is supposed to possess some nutritious properties. In the last report of the State Mineralogist for California, Mr. G. H. Hanks says that diatomaceous earth is being used in that country for numerous purposes; among others—

1.—To make Silicate of Soda and Potash for the manufacture of Porcelain.

2.—Slabs of it are used as absorbents in laboratories.

3.—Floating bricks were used in the time of Pliny. The secret of making these had been lost, but was lately re-discovered, diatomaceous earth being mixed with 1—20th part of clay and burnt. Specimens were to be seen in the Paris Exposition of 1878.

4.—A lump of diatomaceous earth fixed on to the end of a wire and dipped in petroleum makes a good fire-lighter, and can be used over and over again.

5.—In Germany, the "flint-froth" is used in the manufacture of dynamite, as it absorbs four times its weight of nitro-glycerine.

6.—In South Carolina, the land in some places is rich in diatoms, which is said to account for its fertility, and we know that the Guano, so much used in this country, owes some of its properties to its diatomaceous character. Mr. Hanks also says that it is used in the manufacture of soap; and last and most curious of all, the well-known "Vegetable Sozodont Tooth-Powder" is composed of diatomaceous material, and makes a good microscopic slide.

All these facts show how important it is that we should know more of diatomaceous formations than we do, and the study of these organisms is recommended to every beginner in microscopic work, as the care, skill, and dexterity requisite to resolve even the simplest form give a steady hand, require much perseverance, and make the worker observant and a neat manipulator.

To anyone so disposed, this locality (Stroud) affords ample scope for working, as there is not a drain, ditch, or pond where these structures may not be found in quantities. When going my own rounds, I often take a dip with my bottle and generally meet with a good reward, as so many beautiful forms exist without going far away. Amongst a few localities in which I have collected are :—

Stroud Upper Reservoir—*Cocconema* and *Pinnularia.*
Seven Springs, Bisley—*Diatoma vulgare* and *Gomphonema.*
Salmon's Spring—*Synedra radians*, *S. nobilis*, etc.
Stratford Mill Pond—*Surirella* and *Pleurosigma.*
Lightpill—*Cocconema lanceolatum.*
Pond, Bowbridge—*Pleurosigma*, etc.
Heven's Spring—*Navicula.*

Some other forms from different parts of the world may be interesting to mention; for example, the Sozodont Tooth-Powder before alluded to. This diatomaceous deposit comes from Virginia City, near Nevada, California; and in addition to its use as a dentifrice is applied to the manufacture of what is known as "*Rock Soap*" and the "*Electoric Silicon.*" From Nevada City, Maryland, U.S., we get forms of a similar character to the so-called Bermuda earth (New Nottingham deposit). Coming nearer home, a deposit from the Humber pond-beds, and another from the Thames mud, both show fine forms of diatoms.

Mr. Kitton has sent me some Bergh Mehl, or "rock-flour," a term applied to diatomaceous deposits, especially of fresh-water origin; also called *Keeselgurh*, a miner's term for wet or sloppy layers. It is also called *Essebare Erden*, on account of being

used as flour by the Lapps, Indians, and Chinese, in times of dearth. Bergh Mehl is an indefinite term, and applied to all diatomaceous deposits of the same character as those in Norway and Sweden. These two are exceedingly interesting, and one is composed entirely of diatoms, as may be seen under the microscope.

By this short list, we see that many different forms are to be found in certain localities, and it occurs to me to enquire whether there are any conditions of soil or water to which these peculiarities are owing; for instance, why do we get polygonal forms in one place and a rounded or semi-circular form in another?

Circular forms are more abundant in sea-water. The Rev. W. L. Smith, in his "Synopsis," says that "The discoidal forms of diatoms constitute about 30 per cent. of the total number of genera—the polygonal forms about 10 per cent.—and the remainder have more or less of a Navicula contour." Most of the fresh-water genera are represented in brackish and in sea water, and by far the larger proportion of discoidal and polygonal forms are marine. The presence of Silica in water has much to do with the robustness of the diatoms. I fancy that I have noticed, in some instances, that the harder the water the more elongated in shape are the diatoms, but of this I am not yet satisfied.

But all of these organisms are worthy of notice. Being so numerous, no doubt they play some important part in Nature's economy, as when living they assimilate and appropriate the soluble constituents of the water, especially Silica. They give off, also, as may be seen in the living specimens, a large quantity of Oxygen, that must not only impregnate the water, but as it is one of Nature's purifiers, must assist likewise in keeping it pure and wholesome by the oxygenation of its constituents. This suggests the thought, "Would not the presence of so much Silica make it an excellent filtering medium?" We know how well the Silica-filters do their work, and if diatomaceous earth could be obtained in sufficient quantities, it would no doubt make a good filtering medium by being first burnt, and then mixed with the usual proportion of carbon.

I hope, by these few and unconnected remarks, that some will be led to look more after, and investigate these beautiful and wonderful structures. If we just think that one of these little objects requires a power of 400 or 500 diameters at least, to show anything like its structure, and that it exists in millions and millions in our rivers, lakes, and streams, and is playing such an important part in the world's history, we shall then see the value of studying them, not simply straining our eyes to resolve dots, and holding long arguments as to

whether they are elevations or depressions, or whether the fracture be transverse or oblique; but rather studying them in their Geological, Physiological, and Physiographical aspect, which will not, in my opinion, fail to prove both interesting and useful.

How to Prepare Foraminifera.

First Paper.

THERE are probably few cabinets of microscopical slides which do not contain specimens of the Foraminifera. The simplicity, *the complexity*, the great variety of structure, added to the extreme beauty, of these minute shells, have ever caused them to find a place amongst the many "odd things" which the microscopist delights to own. Until quite recently, a very general ignorance prevailed as to what these shells really were. This has been somewhat broken into of late by the impetus which has been given to their study, owing to their connection with the very lowest forms of animal life, and to the yet very important part they play in making up the shell of the globe on which we and they live.

The object of this paper being to give such information as will assist students to obtain and to prepare these organisms for the microscope, any disquisition as to *what they are* would be foreign to such a purpose.

Foraminifera are essentially marine, and may be found on almost every sea-coast, although a few species exist which belong to brackish water. In some places they abound to such an extent as to compose nine-tenths of the shore material, and may there be gathered by the ton. The best time for shore-collecting is at the lowest low-water, when, by means of a spoon, or, better far, the half of a razor-shell, the surface of the sand between the ripple-marks may be gently scraped off and bagged; or, the whitish lines and streaks left by the receding tide on the sand; or, again, the white lines left on rock surfaces by the high-tide, may be so treated. Shore *débris* is generally rich in Foraminifera. Sponge-sand; the sand often found in large sea-shells; what is known as coral-sand; the "dust" which shakes off dried seaweeds which have been dredged from the bottom of the sea—all these are sure to contain a greater or smaller proportion of

Foraminifera, Ostracoda, and other microzoa. The surface of muddy, oozy sea-shores is mostly peculiarly rich in these delicate shells. They also occur, in some instances plentifully, in sea-soundings at all depths; in the mud deposited at the mouth of all tidal rivers; in the mud and marl found in the "raised beaches" (which are far from uncommon), though sometimes many feet above the present sea-level, and, it may be, miles away from the sea. What is known as "Estuarine Clay" and "Boulder Clay" is often richly stored with them.

In all the above, the Foraminifera present pretty nearly the same appearance, as a rule, and may, for the purposes of this paper, be regarded as "recent."

Fossil Foraminifera are abundant in almost every clay found in the Lias, in the London Clay, in the Suffolk Crag, in the Carboniferous Limestones and Shales, and in the Chalk, being especially well preserved in the soft powder found in the interior of the large flint nodules called "Paramoudras," of which I shall speak in a future paper.*

The methods adopted for separating the Foraminifera from the materials in which they occur vary according to the character of that material, the "recent" requiring very different treatment to the "fossil." All recent Foraminifera being full of air when dry, will (except the very large ones) float in water; but all fossil Foraminifera, being generally solid casts more than simple shells, sink to the bottom. By availing ourselves of this power of floating, we secure with very little trouble a ready means of separating the shells of the Foraminifera, Ostracoda, etc., from the sand with which they are generally intermixed, and thus reduce what would otherwise be a most tedious and difficult operation, involving an enormous sacrifice of time, into one which is at once simple, easy, rapid, and satisfactory, and which is performed somewhat as follows:—

To obtain recent Foraminifera *from sand*, such as shore-gatherings, dredgings, etc.

If wet and fresh, stir up in *plenty* of cold, *fresh* water, in order to remove as much of the salt as possible, and if time is no object, allow to stand all night, so as to soak out *all* the salt. Skim off everything that floats, picking out bits of weed and such-like, and examine the same for any forms which may be adhering to them. This washing may be most easily done on a VERY fine sieve, which can be put into a large pan and kept under a tap of

* Paramoudra is the name given to the large, irregularly cylindrical, but really amorphous masses of flint, large as a chimney-pot, often found in chalk, two, three, four, or more, one over the other, something like a chimney-stack! What these *were* is not yet known.

running water. An excellent substitute for the sieve is a *good*, fine linen handkerchief (*without holes in it*), stretched across a colander so as to make a deep basin in it. The best material for the sieve is miller's silk-gauze, 180 threads to the inch, which is very strong and durable; if fewer threads than this per inch, minute forms will slip through and be lost. When the salt is washed out, dry the sand *perfectly*, in any convenient way, and allow it to get quite cold, after which it should be passed through a fine sieve (No. 50 or 60), or a *very fine* gravy-strainer. The "coarse material" which does not pass through the sieve should be examined, as most of the larger forms, which would not "float" in the subsequent process, will be found in it.

The Foraminifera are separated from the fine, or sifted, material, as follows:—

Procure a deep vessel, holding about three or four pints, such as a *round*-bottomed (not flat) milk-basin, or a common two-quart tin, with a lip, into which pour a cupful of the fine material, and then fill with clean, fresh, *cold* water, up to about half-an-inch from the top. Stir this *well* with a spoon, breaking all bubbles which may arise, and then allow all to stand for one or two minutes for the sand to settle. The Foraminifera, having their chamberlets full of air, will be found floating on the surface of the water like a scum, and may be easily poured into a filter by tilting the basin towards the spout or lip, and gently blowing the surface at the same time. A very little practice will teach how to do this so as to remove, by this operation, little more than the scum itself. The *dry* finger should then be gently carried round the edge of the basin, with a sort of revolving motion (so as not to crush the delicate shells), to remove those adhering to the side, and these, by means of a "washing-bottle," or other gentle stream of water, may be washed off the finger into the filter. Fresh material may be added, and thus "floated" until all the gathering has passed through the process. It is well not to let the basin get more than half-filled with sand. Each cupful of this should be well stirred up two or three times so as to secure all the shells that *will* float, but of course the greater part floats with the first stirring. It is desirable to float all the water off the sand through the filter, so as to catch everything.

The sand left in the basin may then be put on a soup-plate, and should be well shaken, by slapping the outside with the hand, which will cause most of the larger forms which have not floated, and are still buried in it, to come up to the top, whence they may be easily skimmed by means of a teaspoon. These should be kept separate from the "floatings."

The "floating" being finished, let the filter-paper drain to

the bottom, and then, by means of a "washing-bottle" (or its equivalent), begin at the top, and wash the shells to the bottom of the filter, *using as little water as may be.* The filter must then be carefully and *perfectly* dried, after which the "floatings" are ready for examination. If the different operations just described have been properly performed, the Foraminifera will be found clean and bright, and fit for mounting.

Sometimes, however, it happens that a quantity of minute fragments of algæ, or vegetable matter, which was present in the "gathering," has also floated—which quantity may be much in excess of the shells, and may even be firmly adherent to them. This may be almost, if not entirely, removed, by carefully boiling the floatings (after drying), in the common *liquor-potassæ,* strength B.P., as sold by chemists, after which the floatings *must be well washed* in clean water, so as to remove every trace of the potash (boiling in, at least, two waters is best), then dried, re-floated in a beaker, and dried again. The result will always amply repay for the additional trouble it entails. The floatings are best kept in flat, "shouldered" pill-boxes, care being taken to label each lot as it is done, so as to avoid mistakes respecting locality, etc.

It will sometimes be found, where the sand is *very* fine, (*e.g.*, sponge-sand), that the air clings so tenaciously to its surfaces, that a quantity of it will also float with the Foraminifera. I have frequently overcome this annoyance by blowing off the floatings into a pint beaker-glass, and after nearly filling this, have well stirred all up, and allowed a sort of second floating to occur, by waiting four or five minutes, and then blowing off the scum from the beaker into a filter-paper, which was dried, etc., as before described. But when doing this—and it is often worth doing—the sand which settles to the bottom of the beaker should also be dried and examined, as generally it will be found to contain many shells.

The various operations just described may be now summed up thus (for Shore-sand and such like):—

1.—Well wash in fresh water to remove the salt.
2.—Dry *perfectly*, and allow to get cold.
3.—Sift (sieve No. 50 or 60).
4.—Float the fine material in cold, fresh water.
5.—Dry the floatings.

Perhaps it may also be found needful to—

6.—Boil the floatings in *liquor-potassæ*, B.P.
7.—*Wash away every trace of potash.*
8.—Dry.
9.—Re-float in a beaker.
10.—**Dry again, ready for mounting.**

This process, though seemingly tedious, is one which can be confidently recommended, as ensuring success, if followed with ordinary care.

The next Paper will detail the means by which Foraminifera are obtained when embedded in mud, clay, etc.

CHARLES ELCOCK.

Belfast.

Lichens.

A PAPER READ BEFORE THE STROUD NATURAL HISTORY AND PHILOSOPHICAL SOCIETY, BY THE REV. H. P. READER.

THOUGH the study of the flowering plants, at least in a superficial way, is very general in these days, it is still a fact that the investigation of the Natural Orders of what are known as flowerless plants, or Cryptogams, is by no means popular. This is sufficiently to be accounted for by the difficulties which the Cryptogamic Orders undoubtedly present, by the comparative absence of introductory or popular literature on the subject, and not a little, perhaps, by the absolute necessity of careful microscopic work in this department of botany, which renders it formidable to many, and out of the reach of some. This being the case, those who are already familiar scientifically with the Lichens will pardon me if I premise my remarks on the Lichen-Flora of our neighbourhood, by an explanation of these plants for the benefit of a possible majority who are not so familiar with them.

Lichens, then, form a Natural Order of flowerless plants, composed of cellular tissue alone, and are generally considered to hold an intermediate place between the Algæ (or Order to which the Seaweeds belong) and the Fungi—approaching the former chiefly by the Gelatinous Lichens, and having the closest affinity with those Fungi of which the spores are enclosed in cases. Those Lichens which are most familiar to the eye, clothing especially the trunks and boughs of trees, appear to consist principally of what may be termed a membranous expanse of a hoary-grey, yellowish, or greenish colour, variously lobed and

indented at the edges, or pendent in long, somewhat rigid, and beard-like filaments. This membranous substance of various form is called the *thallus*, and represents a very well-known and common, but by no means universal, thalline form. Many thalli are scaly, or scurfy, or powdery, or gelatinous; and many again exist only during the early stages of the Lichen's life, disappearing completely eventually. Still, all Lichens, with the exception of a few parasitic species, have a thallus of one kind or another, at least for a time; and all thalli have much the same structure. Three distinct layers are almost always present, called respectively the cortical, gonidial, and medullary layers. The cortical layer forms the upper surface—the bark, as it were—of the thallus, and is composed of minute cells closely compacted together. Beneath this is the gonidial layer, consisting of a series of cells, filled with a green colouring matter, which seem to lie close together, but without any actual union, and which are called *gonidia.* These gonidia, which have the power of reproduction by bisection, or splitting into parts (like many Algæ), are at the present day the subject of very warm discussion amongst cryptogamic botanists, and upon them is based a controversy which affects so important a point as the right of Lichens to rank as a distinct order of plants. No adequate distinction has hitherto been recognised between the Lichens and the Fungi, except the presence in the former of those spherical green bodies; and a theory has of late years been broached, and obtained some adherents, that these gonidia are in reality unicellular Algæ, upon which various Fungi, constituting the residue of the so-called Lichens, are parasitic. According to this dual theory of Lichens, as it has been termed, these plants are merely a composition of Algæ and Fungi; and if it has met with some clever exponents and defenders, it still lies open to very serious objections, and is considered untenable by many of our leading cryptogamists.

There still remains the medullary layer—a mass of colourless, interwoven filaments, from which, in many of the foliaceous species, root-like organs spring, serving to attach the plant firmly to the substance on which it grows. A vertical section through the thallus of *Peltigera canina*—a large, membranous Lichen of an olive-green colour, turned up with brown, to describe it roughly—shows these layers readily under the microscope. Where the air is unfavourable to the growth of Lichens—and these plants never flourish where the atmosphere is impure—masses or communities of gonidia will increase and form pseudo-thalli; but the reproduction of the perfect Lichen is effected by special organs—*spermatia* and *sporidia*, enclosed in special receptacles—*spermogonia* and *apothecia.* The spermogonia are usually very

minute and inconspicuous tubercular bodies on the surface of the thallus, lined internally with the cylindrical, straight, or curved spermatia, whose office it is to fertilise the spores. The apothecia, on the other hand, are easily detected by the eye in most cases. A common yellow Lichen, forming circular patches on most of our walls, is seen to be studded with reddish shields or targets, the apothecia of the plant, containing numerous colourless, pear-shaped vessels, which in their turn enclose the spores. These cases, known as asci or thecæ, are surrounded by filaments called paraphyses, which are welded together more or less firmly by a gelatinous substance, and which serve to protect the thecæ.

The appearance which the apothecia present differs widely in different genera, though the internal structure is much the same in all, and amongst our own Lichens we may easily collect types of the principal variations. The shield-like form, to which I have alluded, is common. Again, certain apothecia resemble shallow cavities, or cups, sunk in the substance of the thallus. In the large genus *Verrucaria*, the apothecium is entirely covered by an integument known as the *perithecium*, which gives it a remarkably convex appearance, and eventually opens by a pore, through which the spores escape. The genus *Pertusaria*, common on trees about us, is in reality one of the most abundantly fertile of our British genera, and has spores of enormous dimensions, comparatively speaking;—but the apothecia might easily be passed over, and the Lichen regarded as sterile, owing to the fact that tubercles composed of thalline substance almost completely envelope them. But by far the most remarkable fructification is that of the *Graphideæ*. A close observer of the tree-trunks in our beech-woods will have noticed pale spots on the bark, definitely bounded by darker lines, upon which are traced most singular markings, which can forcibly be compared to the letters of the alphabet of some Oriental language. These weird and mysterious-looking characters are in reality the apothecia of the genera *Graphis* and *Opegrapha*—sometimes simple, often confluent, branched, and radiate, and always much elongated. Such specific names, as *Graphis scripta* (the *Lichen scriptus* of Linnæus) and *Graphis sophistica*, reproduce the impression conveyed by these curious forms.

Lastly, I may mention the odd little stalked fructification of the genus *Calicium*, which is very fungoid in appearance and structure. The *thecæ*, or spore cases, are usually pear-shaped or flagon-shaped; but the spores themselves vary considerably in shape, size, structure, colour, and number: the number in each theca being, however, almost constantly the same in each individual of a species. They may be egg-shaped, elliptic,

spindle-shaped, linear, pointed at both ends or only at one, constricted in the middle, or nearly globular. Most of them are straight, but others are curved, or even spirally twisted. Some are simple (or undivided), whilst many have one, three, five, seven, or more numerous divisions. A very large proportion are colourless, but not a few are yellowish, brownish, or nearly black.

I have thus summarised the leading features and distinctions of the various parts of a Lichen, having purposely confined myself to such genera as are represented locally.

It is an undoubted fact that a pure, keen air, and especially the salt sea breezes, are highly conducive to the growth and fertility of these plants. To see them in their highest perfection and greatest abundance, we should have to seek cliffs and mountains such as we do not possess here. However, if we cannot boast of such a Lichen-Flora as adorns the Welsh mountains, or the Cornish sea-boards, we have still one quite varied and ample enough to provide the student with working matter for many a day. The British Lichens are by the most recent authorities divided into 76 genera, comprising in round numbers some 2,000 species. Some of these genera are very large, and the species composing them not readily to be distinguished without long and minute examination. I am not at present in a position to estimate, satisfactorily to myself, the number of species which our neighbourhood may possess. I have, however, myself collected examples of at least one-third of the 76 genera, within three or four miles of Stroud—which, all things considered, seems a very fair proportion. As time goes on, many new discoveries and additions may confidently be expected, especially if fresh workers should present themselves in this much-neglected field of botanical knowledge. As an encouraging fact, I may mention that, at any rate, one Lichen, new to science, has been added of late years to our local Flora.

Excepting those Lichens which are of world-wide distribution—such as the common yellow *Placodium murorum*, which ranges from Britain to Australia, from Patagonia to Labrador—I should characterise our own Lichen-Flora as being pretty strictly of the N. European type. More southern forms, however, approach so close to us as the St. Vincent's Rocks at Clifton, and some of them may probably be found nearer home. Our most numerous and best-developed Lichens are saxatile or stone-loving—clothing walls in exposed situations, such as Selsley Hill, or Minchinhampton Common, with various tints of yellow and grey. The arboreal, or tree-forms, are not so abundant, nor by any means so generally fertile. Beech-trees, of which our woods are mainly composed, are not great favourites with these plants; indeed, they seem often to remain perma-

nently in a gonidial state on their trunks, or instead of producing apothecia, develope only those white pulverulent masses known as *soredia*. Oaks, provided damp or want of sunlight do not stand in the way, usually repay research; and Ash-trees are almost invariably clothed with Lichens. Wall-tops coated with mud produce some terrestrial forms, including *Peltigera*, which spreads in large patches, greenish when wet, grey when dry, and bearing numerous chestnut-coloured apothecia on the edges. *Collema* may be found there, too, a gelatinous genus with no cortical layer. But Lichens which grow on earth are by no means numerous with us. Turfy and sandy soils are what they chiefly affect, and these are precisely what we do not possess. *Bœomyces rufus*, however—a terrestrial Lichen, having a bluish-white, pulverulent thallus, and stalked, pinkish apothecia—occurs with one of the scarlet-fruited Cup-Lichens (*Cladonia digitata*) on a certain piece of ferny ground on the outskirts of Woodchester Park, which has in other respects a very peculiar and distinct flora of its own. Our hill-sides produce the Reindeer Lichen—well-known as forming the principal food of that animal during Scandinavian winters —and two or three allied species in some abundance.

Amongst the localities easily attainable from Stroud, though rather outside the radius I have been considering, Oakley Park, Sapperton and Hailey Woods, and the stone wall separating the Berkeley Canal from the Severn at Sharpness Point, deserve special recommendation.

The student of Lichens must remember that these plants are not always easily seen, and careful scrutiny will often detect their presence abundantly, where at first sight they seem to be wanting. A pocket-lens for examining bark and stones will be found useful, and rainy weather has at least this advantage—that it renders them more conspicuous. They share with mosses this recommendation—that after being collected they may be set aside without anxiety, to be examined at any convenient opportunity. After months, or even years, they can be restored to their pristine condition by a few drops of water.

As regards their examination, a general view of the thallus can be taken with an ordinary magnifying-glass; but for investigating the internal structure, the microscope is essential. Where a section cannot be made, a small fragment of an apothecium should be placed on a slide in a drop of hydrate of potash, with a covering-glass over it. When this fragment has become well moistened, it must be rubbed down till it becomes transparent, when a good quarter-inch objective will show the internal organs. The colour, shape, size, and internal divisions (if any) of the spores can then be observed, and the presence or absence of paraphyses noted. In examining spores, accurate focussing is

very necessary, and the student should not content himself with observing only one or two. The number of divisions, or septa, often mark out large groups of species in the more extensive genera, and their extreme tenuity causes them to be easily overlooked. I have noticed that apparent septa are often produced in really simple spores by the presence of green nuclei; but careful examination will reveal their true character.

An Hour at the Microscope,

With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

PLATES 2 AND 3.

[UNDER this heading it is proposed to give, in successive numbers of the Journal, selections from the full and varied Notes written by Mr. West on the numerous slides which passed through his hands whilst President of the Society. They will serve to show, in his own words, his general method of dealing with a box of slides, his arrangement of their contents, his kindly criticisms, his genial and instructive comments upon each object passed in review before him, as well as the vast stores of information which he had ever at command on every subject connected with the Microscope. The long and serious illness that has for the present laid him entirely aside from all work, and deprived the Society of his valuable help, is an event deeply to be lamented, not by this Society alone, but by all who are interested in Microscopic pursuits.

Let us, then, as it were, go with Mr. West into his study, and look on while he examines a box just arrived, and hear what he has to say respecting its contents.]

It will, perhaps, be advantageous if I here make a few remarks on the most profitable way of studying the contents of our Postal Boxes. The world of natural objects is practically infinite:—**Method, Arrangement, Classification,** are, therefore, absolutely necessary as aids to remembrance. Without such, the most gigantic powers of memory fall helpless; with them, by

judicious grouping of facts, the task becomes practicable even to ordinary minds, and increasingly delightful as the hidden links in the plan of "THE MASTER BUILDER," which connect one form with another, become gradually unfolded. Hence it is, that in all modern works on natural history, so prominent a place is assigned to the subject of classification. Authors in their preparation find it requisite to carefully collate their facts; taking first the simplest and most rudimentary, they proceed thence to those whose organisation becomes increasingly elaborate.

I regret very much to find, even yet, so little appearance of thought, on the part of many of our members, as to what they shall put into our boxes, when the favoured opportunity comes for so doing. It seems to me as if a glance were taken at the Cabinet, and almost the first thing to meet the eye were put into circulation. Or it may be that one of the last-mounted is considered, without any idea of connection with what may have gone before, to sufficiently meet the need of placing *something* in. This would be natural at first. But could we not now aim at something better? There will always, with real workers, be abundance of material to show, for the sake of its novelty. But many of our slides can scarcely, without any approach to fairness, come under such a heading; though they may sometimes be given in *further elucidation* of subjects already partially shown.

In the list upon which these remarks are based,* it will be seen that mineral or geological slides are placed first. Diatomaceæ, as representing some of the humblest vegetable forms, and so largely impregnated with mineral matter, follow. Next to these come, cuticular appendages of higher plants, and starch as amongst "Cell-contents." Then we have a Hydroid Zoophyte, and one of the Molluscoid-Bryozoa; which, with much external similarity of form, yet possess, in rudimentary nervous system (with some at any rate), an anal outlet, a decidedly higher type of organisation. This juxta-position leads to reflection on the reason why forms that *seem* so nearly related, require to be widely separated. As examples of Insect-structures, appear the head of "Crane-fly" and "Teeth of Blow-fly." Acari succeed these, and are followed, lastly, by one of the dermal structures of a fish, with its remarkable tooth-like structure; which introduces us to the investigations, into the true nature of teeth, with the surprising results obtained, principally by Williamson and Huxley, of the essential identity of dentinal and dorsal structures.

* Names of Slides in the Box:—

Elvanite.	Gemellaria loriculata.
Crysolite.	Head of Crane-fly.
Pinnularia viridis.	Teeth of Blow-fly.
Leaf of Vegetable Marrow.	Gamasus from Humble-Bee.
Starch, Cape-Coast Castle.	Mites.
Laomedea gelatinosa.	Spine and Scales of Dog-Fish.

I think it much the best, after taking the slides carefully out when the box arrives, to place them in a shallow tray; which may be easily made out of card, or a draper's box answers the purpose admirably. There they can remain, taking up each *seriatim* for examination and comparison, until the time arrives for packing up and sending off again. In this way, too, any links of connection between the various slides will be readily seen; and fresh ones, not at first perceived, will occasionally suggest themselves. Some members appear to place them in a cabinet, amongst their own slides, which, however, involves the risk of troublesome admixture unless there be a vacant drawer which can be utilised for the time being. Marking on the labels of the slides themselves to prevent any confusion of this kind I have several times noticed, and consider quite an unwarrantable liberty.

We are all greatly indebted to the Rev. J. M. Mello for the opportunity of inspecting, from time to time, his illustrations of Micro-Petrology (Pl. 2, Figs. 1, 2, 3). May I venture, on behalf of those who have not worked so deeply at this interesting, yet novel, branch of research as he has done, to ask him to make his terms as simple as may be, and to explain the meaning of such as it appears requisite to use? "Orthoclase," "Twin-Crystals," "Quartz porphyritically developed," "Oligoclase," "Oliogoclastic," and "Sanidine," may be taken to illustrate what I mean. With every desire to gain all that may be learnt from examination of his slides, and after spending many hours of valuable time in hunting over books likely to help, with various detached papers, I have to confess inability to comprehend the meaning of all of them, so as to get a lucid picture of what they put before us.

The chalky whiteness to be often seen at the enlarged base of the hairs of **Vegetable-Marrow** leaf is doubtless due to the presence of Carbonate of Lime in the cells, as has been shown by Professor Gulliver to be the case with a similar appearance in the leaf-hairs of Viper's Bugloss (*Lycopsis arvensis*). It would be easy to try this by tearing part of a mature leaf to pieces on a slide, adding acetic acid, and then watching for the appearance of effervescence. Although the *Cell-contents* are so different, the structures by which these hairs are built up are nearly the same as with the Nettle tribe; whereupon Lindley has some interesting remarks on relationships between these two Natural Orders, otherwise apparently so remote (Lindley's Vegetable Kingdom *in loco*). It is easy to make a little confusion between the scattered whiteness visible in the decaying leaves of Vegetable-marrow, which is caused by these hairs, and that which is due to the overspreading of an Oidium, a form of fungus undis-

tinguishable in such condition from that which causes the vine-blight and the hop-mildew; but careful examination will readily show the difference.

Teeth of Blow-Fly.—In the "Entomologist" for March, 1873, at p. 336, appear some remarks "*On the Food of Eristalis and other Diptera,*" which may be cited for the valuable light thrown by them upon the structure of the proboscis of various members of that order: "As to flies, it has been until now generally admitted that they are exclusively destined to fluid nutriment; but in the summer of 1867, I was surprised, while observing in my garden an *Eristalis tenax* upon a flower of *Œnothera media*, to discover that it was eating the pollen. Resting upon its middle and hind legs, it thrust out its fleshy proboscis like an arm, seized a morsel of pollen with the two valves which terminate the proboscis, and tore it away from the anther. Since the pollen-granules of Œnothera are tied together by elastic threads, that bit of pollen torn from the anther was attached to others by a band of threads; and the insect, in order to free its mouth from that inconvenient appendage, began to use its fore-legs. Raising both together towards its mouth, it seized between them the cordon of threads, and rapidly rubbing them one against the other, much as we do in washing our hands, succeeded in cutting the threads and clearing them from its mouth and legs; then it raised them again, and seized the two valves of the proboscis, thoroughly cleaning them of pollen and the threads yet adhering to it; and in about three seconds this work of cleaning was complete. At the same time, the valves of the proboscis, by rubbing against each other, had masticated the morsel of pollen, and had conveyed the single granules into the channel of the labium, whence they were pushed into the mouth. It had hardly finished cleaning its proboscis, and eating the first mouthful of pollen, when it seized another portion, and repeated each and all the operations I have described. It was so intent upon its meal, that I was able to observe it in the closest proximity without its manifesting the slightest fear. The quantity of pollen which an Eristalis can devour in this way is surprising. Upon making a section of one and examining the stomach, it appeared very large, and was full of a yellow substance, which consisted of hundreds of thousands of pollen-grains. I have since then had many opportunities to observe this eating of pollen, not only in all the species of Eristalis, but also in the genera Rhingia, Syrphus, Volucella, and Scatophaga. This chewing of pollen alternates with sucking honey, if the flowers have any; and I am of opinion that the singular structure of the proboscis of flies cannot be fully explained, without taking into account its double function of

sucking honey and eating pollen. In the Tipulidæ, and also in those flies which do not eat pollen, but live exclusively upon juices—for instance, Bombylius—the two valves of the proboscis serve no other purpose than to protect and guide the sucking-tubes; but in the flies which devour pollen, besides this function, there is also that of grinding the pollen, for which they have special adaptations, for the margins of the two valves at the point of union are transversely dentate with fine and parallel bands of chitine. Probably, the greater or less distance of these bands in different species is related to the different size of the pollen upon which they feed."—(Dr. Erm Müller, of Lippstadt.)

I have not met in my readings with any observations on the Blow-fly as a pollen-eater; nor does it follow that because teeth are present, such must always be their function; but in the warm days of autumn, when grapes are ripening, they do much injury to this fruit by making holes in the "skin," and eating largely of the juicy contents.

Dermanyssus gallinæ, the fowl-mite, when present in numbers, occasionally causes troublesome eruptions on human beings; and they may also become a serious nuisance to horses in stables. A graphic account of the latter, too long to extract here, will be found in Vol. III. of Gamgee on "Our Domestic Animals in Health and Disease," at p. 213.

Spine of Dog-Fish.—All the slides which I have seen named "Skin of Dog-Fish" are from *Scyllium caniculum*, the Smooth-spotted Hound, a portion of the skin of which is shown on the upper part of Pl. 3, Fig. 2. The spine, from which the section figured (Pl. 3, Fig. 1) has been taken, is from *Spinax acanthias*, the Picked (or spiked) Dog-Fish. These do not differ greatly in size, though the former under favourable conditions grows to be larger. The differences in colouring, however, are great. In the "Smooth-Hound," the general colour of the body is pale reddish on the upper parts, covered with many little spots of dark reddish-brown; below it is yellowish-white. The "Picked Dog-Fish" is of a bluish-grey, darker on the back, and becoming almost white on the belly. It is further characterised by the possession, in front of each of the two dorsal fins, of a long, tapering, acute, and very hard spine (Pl. 3, Fig. 3), with which, unless the fish be handled with great caution, fearful wounds may be inflicted. They sometimes occur on the North-Eastern Coast, in large shoals, and are much disliked by the fishermen, who, it is said, used formerly to cut the livers out, and then cast the poor brutes, still living, into the sea again. Those who have not imbibed the stupid prejudices against them

which are so rife, will find the flesh white, delicate, and wholesome.

Zones of growth are clearly to be seen in the Section. What periods of growth these may indicate is, I believe, yet a moot question.

TUFFEN WEST.

IN his Notes, Mr. T. West has observed, that more detailed description of some of the names used in microscopical notes on rocks might be useful to some unacquainted with the subject. I will, therefore, add a little explanation in reference to Felspar, etc.

The Felspars belong to the Siliceous group of minerals, and are divided into two great groups:—1st, the Monoclinic or Orthoclastic; and, the Triclinic or Plagioclastic.

The cleavage-planes of the former form an angle of 90°; those of the latter, of less than 90°.

I.—Orthoclase; composition, K Si + Al Si3, part of the Al (Alumina) may be replaced by Fe (Iron) or Mn (Manganese) and part of the K (Potassium) by Na (Sodium) or Ca (Calcium).

Its varieties, according to Colour or Lustre, are:—1.—Adularia; 2.—Common Felspar (the ordinary Orthoclase of Granite, etc.); 3.—Sanidine (only found in true volcanic rocks).

Orthoclase Felspars are essentially Potash Felspars.

II.—Plagioclase; composition Na Si + Al Si3. Ca, K, or Mg, may replace Na.

1.—Oligoclase. 2.—Labradorite. Some of the Na may be replaced by Ca. The rich play of colours shown by this is due to numerous inclosures, consisting of Microlithic needles and plates, the latter being frequently crystals of Hæmatite, yellowish by transmitted light, but gorgeous in reflected; specular iron also occurs. These Microlithic inclosures, as a rule, follow the cleavage-planes of the crystals, or sometimes they cross them. 3.—Saussurite (impure Labradorite). 4.—Anorthite.

Opalescent Felspar, or Labradorite will be found extremely beautiful if viewed either as an opaque object, care being taken to rotate it under the light, so as to get the most brilliant effects of colours; or else as a polariscope object, when the polysynthetic (twin) structure of the Plagioclastic Felspars will be seen.

The Plagioclastic Felspars may almost invariably be known under the microscope by their parallel striping, which in the polariscope presents a very beautiful appearance. It is owing to the parallel growth, side by side, of numerous crystals.

Orthoclase is often found in twins (Carlsbad twins), but never twinned like Plagioclase.

J. M. Mello.

Selected Notes from the Society's Note-Books.

INORGANIC.

Elvanite (Pl. 2, Figs. 1, 2), or Quartz Porphyry, is a rock which occurs in veins piercing through the granite, and is therefore a more recent formation. It will be seen in the Microscope, especially when the Polariscope is used, to consist of a matrix of dull-looking orthoclase Felspar, sometimes forming twins when definite crystals are developed in it. The matrix will be found to enclose numerous clear grains: these are grains of quartz porphyrytically developed. They will display fine colours when polarised. Some accessory minerals occur in small quantities,—amongst them a green one, which is pleochroic; its behaviour is best observed by removing the analyser and rotating the polariser. It is probably Chlorite, a secondary product in the rock, indicating a slow process of change. Oligoclase and Sanidine sometimes are present in Elvanite as well as Orthoclase.

Crysolite, or Olivine (Pl. 5., Fig. 3) (from Atraja, in the Sandwich Isles), is apparently in the form of water-rolled grains, although it must have been originally derived from one of the neighbouring volcanoes. Very few of the grains show very distinctly the peculiar appearance by which Olivine may be so readily recognised in microscopical sections of Olivine-bearing rocks—viz., an uneven-looking, granular surface, usually presenting in the polariscope bright rosy and green colours.

Diorite is a rock consisting essentially of Plagioclastic Felspar and Hornblende; the Plagioclase may be seen, especially when the Polariscope is used, to form a network of beautiful Crystals, showing more or less of twin compositions, the Crystals forming the groups exhibiting striæ of various colours. The Hornblende is best recognised by moving the analyser; when, on the rotation of the polariser, the characteristic dichroism of this mineral will be seen.

J. M. Mello.

DESCRIPTION OF PLATE II., UPPER PORTION.

Figs. 1 and 3.—In the upper half the slides are represented unpolarised; in the lower half the colours induced by polarisation are given; *t. c. t. c.*, Fig. 1, a (supposed) twin Crystal.

Fig. 2.—Portion of the accessory mineral spoken of as having a greenish colour; in the upper half of the circle, the natural appearance is represented; in the lower half, the changes induced (after the removal of the upper prism, as directed), by rotating the sub-stage prism.

Xanthidia in Flint (Pl. 3, lower portion).—These curious and obscure organisms, when first observed, made such a sensation that, it is said, the quantity of flint nodules broken up in the search for specimens amounted altogether to many tons. They are often found plentifully in the fossil state, as many as 20 having been detected in a piece of flint 1-12th inch in diameter; and Hogg says—"It is rare to find a gun-flint without them." There has been much discussion as to what these bodies really are. At first, Ehrenberg and others thought them to be Infusoria, but more recently they have been described as the fossil Sporangia of Desmidiaceæ; their skeletons being shown to be composed of a horny substance, and not of silica, as was once supposed. In form they vary much; generally, they are small, flattened spheres, either smooth, bristly, or furnished with spines, some of which are simple, others branched at the extremities. In one species, the tip of each spine is expanded like a sucking-disc. Sometimes a membrane may be traced, either covering the spines or entangled with them. Some specimens exhibit *bent* spines, and torn margins—appearances which forbid the idea that they were originally siliceous in structure.

Similar bodies have been found in the Chalk near Dover, as well as in flints; and recent specimens have been obtained from the Thames mud, near Greenhithe. But all these deposits are believed to be marine, whereas the Desmids, as far as we know, are confined to fresh water: how, then, has the connection arisen between them?

J. H. GREEN.

I well remember the period referred to by Mr. Green, when stone-breaking was the rage, and the many pleasant hours I enjoyed in my search for these singular forms.

My practice was to split a flint, and then with a light hammer chip off small and very thin flakes, which I placed in Balsam, and by this means could select such as possessed a desired figure. This is not possible in a polished slide. Some time ago I circulated a slide containing 125 Xanthidia.

A. NICHOLSON.

BOTANICAL.

Vital Absorption in Plants.—I have in my possession sections taken from a piece of Larch sent me by Mr. Hyett, F.R.S., of Painswick. The wood is coloured by a process called VITAL ABSORPTION, first tried by Dr. Boucherie about 1839, with a view of testing the effects of different solutions on the durability of wood. Several different things were used. The tree from which the piece under notice was cut was first treated with a Solution of Sulphate of Iron, and then Ferro-Cyanide of Potassium. A hole was bored in the tree (while growing), just at the off-shoots of the roots; then a saw was run through to divide the tree on each side of the hole, leaving sufficient uncut for its support. A bed of clay was made round, and the Solution of Iron first poured in; after two or three days, it was replaced with the Solution of Ferro-Cyanide; absorption took place, and the chemical change followed in the tissues, forming, as is seen in my sections, Prussian Blue. This is interesting physiologically, and also to the microscopist, as showing the colouration of the structure; the most dense being only slightly stained, or not at all, and the medullary rays and vascular tissue more so. I have examined other woods, such as Beech and Elm, that have been coloured with sulphate of Iron only, but fail to detect any crystals. In the specimen referred to, the colouring matter is in the state of an amorphous deposit, an aggregation of which may be seen in places. The late Mr. W. H. Hyett experimented very largely on the effects of different solutions, and their varying effects on different trees. The softer woods were not the only ones experimented on, and, if my memory serves me, he took out a patent for the process. I think he satisfied himself that no useful result would be gained, as the staining was not uniform, and certain parts of the tree, such as the "medullary rays," took the colour better than the woody tissue.

The staircase of Painswick House is inlaid with the several woods experimented upon, in parqueterie work, and the appearance is pleasing.

DR. PARTRIDGE AND COL. BASEVI.

The structure of the **fruit** in some species of the **Palm** bears a kind of resemblance to that of bone:—that of the Date-Palm is not unlike the dentine of teeth. It consists of long oval cells with a central cavity, from which ramify canaliculi towards the cell-wall. In many of these cell-cavities are crystals, which

appear to belong to the class called by Professor Gulliver " short prismatic crystals." I am not, however, quite sure that they are crystals of Lime-salts, as they polarise somewhat differently. The embryo in the Palm is very minute, and the great mass of the seed is made up of albumen—using the word in its botanical, and not in its chemical, sense.

MESSRS. BEEBY AND PARSONS.

ZOOLOGICAL.

Soldier-Beetle, Telephorus (Pl. 4.).—There are two beetles of this family, very commonly found in June—one red, the other with steel-blue elytra;—the latter is much the commoner of the two. It is found amongst grass, stinging-nettles, hedges, etc., and, I believe, it is vegetarian in its feeding.* The mouth (Pl. 4, upper half) is rather peculiar, from its four palpi ending in triangular knobs. The labium and labrum both exhibit traces of the original form of pairs of limbs. The upper—*i.e.*, the inner—surface of the labium has a brush of hairs. The maxillæ are quite covered with hair, and appear to have no sharp claws: I believe that this is rather unusual amongst beetles. It seems that the maxillæ are the homologues of *two* pairs of limbs, each maxilla being two legs amalgamated; this, however, does not appear very plainly in the drawing. It is very instructive to prepare a series of mouths dissected and laid out as in the drawing, which is made from a slide having the various parts mounted and laid out in the position figured.

The folding of a beetle's wing is to me always an interesting problem. In the present instance the doubling is but simple. I do not know the right names of the veins in the wing, but I have named them just for convenience sake in describing them (Pl. 4, lower half). The folding seems to be effected thus:—The lappet, or anal areolet, is turned up to the rest of the wing. The radial and the cubital veins are brought up close to the sub-costal (*r*, *cu*, and *c*), the intervening portion of the wing doubling

* The following remarks, taken from Westwood's "Classification of Insects," vol. I., page 256, will serve to show how careful we should be in forming our deductions:—"They (the Telephori) are very voracious, feeding upon other insects, and devouring such of their own species as they can subdue; the females not even sparing their mates. These circumstances were, indeed, doubted by Olivier, but they have been since authenticated, and I" (J. O. Westwood) "have myself been often a witness of their voracious dispositions."

TUFFEN WEST.

underneath them. These movements I suppose to be effected by thoracic muscles, and by the mechanical action of pulling the wing backwards (like closing a fan). The folding of the tip, I judge, is caused by the natural elasticity of the wing, and it is unfolded when the beetle expands its wings, by the tightening of a tendon that runs down inside the sub-costal vein. This is shown by a line (much too thick) in Figs. 1 and 2, and of its (comparative) proper size in Fig. 4. I fancy that a "round-the-corner" pull of this, at the end of the sub-costal vein, would unfold the tip. The dark colour of the wing in places is caused by numerous fine hairs, shown at Fig. 3.

The great nervures are hollow, and down each one a trachea (Fig. 4.) runs. The smaller nervures seem solid. On the upper side of the sub-costal nervure, close to its base, are two groups of the curious organs supposed to be "otoconia." They are on the surface of the nervure, and are highly refractive of light. They appear to be seated on globular cells within the nervure. Whether they really be organs of hearing, I am unable to say: perhaps some of our members can throw some light on this interesting question. I have found them in every wing that I have investigated, except the May-flies, but they are not always on the sub-costal vein; in the bees they are on one of the joints at the base of the wing.

H. M. J. UNDERHILL.

DESCRIPTION OF PLATE IV.

Upper portion :—mouth dissected and viewed from above.
  ***l.b.r.*, Labrum or upper-lip.**
  ***m.d.*, Mandibles.**
  ***m.x.*, Maxillæ ; *m.p.*, Maxillary palpi.**
  ***l.a.*, Labium, or lower-lip ; *l.p.*, *l.p.*, Labial palpi ; *m.t.*, Mentum or chin.**
Lower portion :—
  Fig. 1.—Left wing folded ; *c.o.*, Costal ; *s.c.*, Sub-costal ; *r.*, Radia ; *c.u.*, Cubital nervures ; *s.c.*, is the tendon which folds the tip.
  Fig. 2.—Right wing spread out.
  Fig. 3.—Group of hairs which give the brown part of the wing their tint.
  Fig. 4.—Small portion of the sub-costal nervure, near its base, upper side showing *t.r.*, a Trachea ; *t.e.*, the Tendon, marked *s.c.* in Fig. 1 ; *s.t.*, supposed Otoconia, or organs of hearing.

Gamasus, from Humble-Bee (Pl. 2, lower half).—These may be found frequently in hundreds on Humble-Bees, but I do not remember ever to have seen them on any other kind of

bee than the genus Bombus. The Gamasi which infest the Dor-beetle are almost identical with these. I generally mount them in two ways—in Glycerine and in Balsam. Those mounted in Glycerine are prepared in the following manner:—

They are either killed by Cyanide vapour, or just wetted with spirit; if put into spirit, they are not allowed to remain long in it. They are then soaked for a day or two in Acetic Acid, until their legs become quite uncurled; then for half-a-day in water, and then in glycerine. They are mounted in a hollowed slip with glycerine, to which two or three drops of Acetic Acid has been added to each ounce of glycerine. This method of mounting is intended to show the natural colour and shape. The muscles are more or less destroyed by the acid, but some of them can mostly be detected, and the natural position of the chelæ is generally well shown.

Other specimens, after having been soaked in potash in the usual way, and then double-stained in order to bring out certain minute details, are mounted in Balsam, thinned with Benzole, and without pressure. This method, in spite of what some have said against it, I still consider greatly superior to the ordinary process of using thick balsam.

The structure of these mites is very interesting. Their bodies are all in one piece, but there is an approach to a division into two parts, as will be seen in Fig. 1, where the carapace is divided into two. The second pair of legs are very curious. In some mites (Dermanyssus) the males have them modified into claws, but in the females they are just the same as the other legs. Although I have looked at perhaps 20 of these Gamasi, I cannot detect any difference. I cannot say whether all were males or all females, or whether they are hermaphrodite. The feet are terminated by a claw and pad of the ordinary type, but the claws are shorter than the pads.

In Fig. 1, by the mark × will be seen very curious organs, which I have noticed in many, but not in all, mites. Mr. Tuffen West seems to consider them tracheæ, and that the holes in which they terminate are spiracles; what they really are, I have no idea, but I cannot think this supposition correct, because two spiracles may be seen in the abdomen, which are very *evidently* spiracles, and which have no connection with, or resemblance to, the other organs. They occur in just the same place as the spiracles in ticks (Ixodes), to which ramifying tracheæ may be seen adhering.

The most interesting part of the mite is the mouth. This is very difficult to understand, and in most specimens it is nearly impossible to make out its details, which can be seen only with a ¼-inch or ⅛-inch objective. In the upper part of the

head is a pair of chelæ, which are furnished with one moveable joint each, so as to make them into pairs of tweezers. They do not work sideways like insects' jaws, but up and down. (In Ixodes they are merely serrated lancets and not pincers.) They are capable of considerable extrusion and retraction, but often in mounted specimens they are forced out too far. I imagine that they are analogous to, if not homologous with, the falces of a spider—*i.e.*, they have no connection with the mouth (strictly speaking), but serve merely to hold the food.

Below the chelæ is the mouth. This has a pair of maxillæ (?) (*mx.*, *Fig. 3*); but I very much doubt if they are moveable, and they certainly do not look as if they could meet. In the middle is a lancet or a rostrum (*r*); this may possibly be hollow. I feel sure that *this* set of organs, and not the chelæ, is the mouth, because the rostrum can be traced to the gullet (*gt*). If this were all, the mouth would not be difficult to understand, but there is also a most curious fringed tongue (*t*). I do not ever remember to have seen this figured and described.

On each side of the mouth is a palpus: the pair form the maxillary palpi. The presence of these palpi is almost universal in insects, arachnida, and myriapoda. Nobody seems to have a very clear idea of their use, but it is generally said that they are for "examining the food," etc. Just below the head of the mite is a little organ with two fringed bristles proceeding from it (*s.o.*, *Fig.* 2). Perhaps this is a sexual organ.* On each side of its base are little thickened plates of chitine. The object of double-staining is to show up the difference in texture of the various parts of the membranous covering of the creature. Thus, the feet are blue and the legs purple, while the membranous joints of the legs and the palpi are blue. Blue and purple, however, do not form by any means a good contrast.

H. M. J. UNDERHILL.

DESCRIPTION OF PLATE II., LOWER HALF.

Fig. 1.—Gamasus of Humble-Bee, viewed from above.
,, 2.—Mouth-parts, more highly magnified: *c.h.*, Chelæ; *m.p.*, Maxillary palpi; *s.o.*, Organ of unknown function.
,, 3.—Mouth proper, removed:—*r.*, Rostrum; *t*, Tongue fringed with hairs; *g.t.*, Gullet; *m.x.*, Maxillæ.
,, 4.—*c.l.*, Claw; *p.*, Pad.

Fowl-Mite, Dermanyssus gallinæ.—It is very curious how slight the difference is between parasitic and non-parasitic mites. The difference between parasitic and non-parasitic

* Mr. Tuffen West thinks there is no reason for assuming this sternal appendage, terminated by two bristles, to be a sexual organ.—[*Ed.*]

insects is generally very great. I have just been examining a series of Chelifers, Cheyleti, Mites of various genera (Trombidia, Dermanyssus, Gamasus), and the Harvest-man Mites, and some Ixodes. The essential differences are really very small, although externally the creatures are very unlike each other. Their relative positions may be arranged thus :—

Ixodes.

- Dermanyssus.
  - Cheyletus.
    - Obisium.
    - Chelifer.
- Gamasus.
  - Trombidium.
    - Harvest-man Mites. (several genera.)

H. M. J. UNDERHILL.

Anguinaria Spatulata (Pl. 3, central portion) is so called from *Anguis*, a snake, to the head of which the cells of the Anguinaria have some resemblance. The snake Coralline is described by Johnson as parasitical on the smaller sea-weeds, "not common." It invests those species chiefly whose stems are clothed with hair-like fibres, as Dasya coccinea, Griffithsia equisetifolia, etc.; but is found occasionally on smooth-stemmed species, as Plocamium coccineum. The Micrographic Dictionary says there are only two British species—*A. spatulata* and *A. truncata*. Anguinaria is a genus of marine Bryozoa, of the sub-order Cheilostomata, and family Eucratidæ. J. FORD.

Fig. 1 represents the whole animal, slightly enlarged; Fig. 2, Head of the same, more magnified; Fig. 3, one of the Setæ.

Kidney of Rabbit (Pl. 5).—I herewith enclose a drawing of the Section of Kidney of Rabbit (Fig. 1), accompanied by copies of figures from "Quain's Anatomy," representing at Fig. 2 the course of the Uriniferous tubules in the Human Kidney; and at Fig. 3, one of the Malpighian bodies (also Human), with its contained glomerulus of blood-vessels. It will be noticed that in Fig. 2 the large tubules which open in the interior of the Kidney are represented as ascending into the cortical substance of the organ and descending again as loops before entering the Malpighian bodies. In Fig. 3 the tubule is seen at the upper portion, and the afferent and efferent blood-vessels at the bottom. A casual inspection might give the idea that the Malpighian bodies were botryoidal or grape-like clusters of cells, but closer examination will reveal their structure as convoluted tubes. These bodies appear to be the secreting elements of the organ.

A. HAMMOND.

Kidney.—The secreting structure consists of tubes (tubuli uriniferi), which commence in flask-like dilatations (Malpighian capsules), near the outer surface. The tubes are convoluted in the superficial, but straight in the central part of the kidney, where they unite together and discharge into the central cavity, from which a tube, the ureter, leads to the bladder. The tubules are composed of a membrane lined by epithelium cells. A minute branch of an artery enters each Malpighian capsule, where it breaks up into a network of capillaries, the Malpighian tufts, which lie free in the interior of the Capsule; these organs unite into a single vessel, which, after leaving the capsule, goes to form a plexus of Capillaries around the tubules. It has been supposed that the urinary solids are secreted by the tubules, the office of the tufts being to allow the watery constituents of the urine to transude, thus acting like a flush-tank at the head of a sewer.

H. F. Parsons.

Section Cat's Tongue.—In the Cat and other animals of the tribe Felidæ, the papillæ attain a large size, and are developed into sharp, recurved, horny spines. These large papillæ cannot be regarded as sensitive, but they enable the tongue to play the part of a rasp, as in scraping bones; or of a comb in cleaning the fur. The small papillæ which are found amongst the horny ones are the sensitive papillæ.

J. Edwards.

PREPARATION AND MOUNTING.

Gizzards are best cleaned by soaking in potash for a day. This destroys the muscles, of course; but the teeth are brought out well, and the muscles might be shown on another specimen mounted in glycerine without soaking in potash.

H. M. J. Underhill.

The simplest way to clean Gizzards is to feed the insect on honey, syrup, or treacle, before killing them; keeping them at the time under a tumbler. They would eat it readily, if it were not too thick to swallow; and in passing through the stomach the

syrup would carry with it any *debris* lying there. This would not be so cruel a process as starvation, which some recommend.

F. J. ALLEN.

The above methods need not be adopted. If the Gizzard be opened and placed in water for a day or two, it will be nicely cleaned by agitating the water strongly by blowing through a pipette.

A. NICHOLSON.

My own plan has simply been to kill the insect in spirit, and leave it there for three or four weeks, or longer: this hardens the tissues, making them less liable to tear, and therefore easier to manipulate. On opening the Gizzard, it will then generally be found clean and firm in texture, the loose particles of food or dirt being soon washed out, either by Mr. Nicholson's plan or any other suitable one. Gizzards are best mounted in slightly-acidulated *Glycerine* in a cell of gold-size, which must be well sealed up. Balsam makes them too transparent, and obliterates many of the finer details.

J. H. GREEN.

Glycerine-Jelly Mounts.—Failures when using this medium are due to two causes—*(a)* imperfect removal of superfluous jelly; *(b)* mounting objects which are springy. The most effective way to remove the jelly is to apply a mixture of whiting, or chalk and water, about the consistence of cream. Let this dry, and then brush off carefully: the chalk absorbs the jelly, and leaves the glass perfectly clean. I use a mixture of Gutta-Percha and varnish for the two first coats of finish; it stands better than varnish alone.

T. LISLE.

Ditto.—Washing the jelly off with a tooth-brush, under water, is a simpler method. Glycerine-jelly should be varnished within half-an-hour after cleaning, otherwise the jelly shrinks from the edge of the cover, and allows the varnish to run in.

H. M. J. UNDERHILL.

Starches.—The nature of Starches cannot be well determined when mounted in Balsam. They should either be mounted *dry*, or in Glycerine Jelly, and viewed as an *opaque object.* Mounting in Balsam prevents the markings on the surface being

distinguished, and only makes a very beautiful Polariscope object, without any scientific proofs as to adulteration, etc.

COL. BASEVI.

A method of mounting Starches strongly recommended in the Journal of the Royal Microscopical Society for June last is as follows:—First prepare a blue staining fluid by mixing together—Soluble Aniline-Blue, ½ grain; Alcohol, 25 drops; Distilled Water, 1 ounce. Then take of Glycerine and Water equal parts, adding a little Acetic Acid, 2 or 3 drops to each ounce; into this pour enough of the staining fluid to make the whole of a decidedly blue colour. Place a drop or two on the centre of a glass slide, and dust some Starch-grains over it, which is best done by touching the Starch with a small camel-hair brush, and gently shaking it over the glycerine. Let the starch-grains gradually sink into the mixture, and then put on the glass cover, pressing it firmly down, and carefully removing all excess of the fluid. On the Turn-table run round a thin layer of Dammar, or Balsam in Benzole; and when this is dry, finish off with coloured varnish.

The Starch-grains never take the staining, but appear in their natural condition, each surrounded by a blue medium, and presenting a very beautiful effect. J. H. G.

Desmids and Confervæ.—In the same Journal is given the formula for preparing a fluid medium in which to preserve these and similar organisms; and in the hope of inducing members to take up more frequently the study of these neglected but interesting plants, it may perhaps be usefully quoted here:—

Take of—

Camphorated Water - -	50 grains.
Distilled Water - - -	50 grains.
Crystallizable Acetic Acid -	½ grain.
Crystallized Chloride of Copper -	2–10th grain.
Crystallized Nitrate of Copper -	2–10th grain.

Dissolve the crystals in the water, mix all well together, and filter carefully.

Monsieur Petit has found this solution better adapted than any other which he has tried for preserving the natural colour of fresh-water Algæ; it is founded on the process used in commerce for preserving vegetables. Desmids, Confervæ, Spirogyra, &c., when mounted in this fluid, have kept their brilliant green tints, even after a year's full exposure to light.

Reviews.

BOLTON'S PORTFOLIO.*

At the moment of going to press, we have received from Mr. Bolton his Portfolio, No. 7, containing 18 outline lithographic drawings, with descriptions on the back of each. Five of the subjects relate to the Vegetable, the other thirteen to the Animal Kingdom. We consider it a very good shilling's-worth.

* Portfolio of Drawings and description of Living Organisms (Animal and Vegetable), illustrative of Fresh-Water and Marine Life, by Thos. Bolton, F.R.M.S., 57, Newhall Street, Birmingham.

Microscopical Apparatus.

Aperture Diaphragm.

This apparatus was described at the last meeting of the "Royal Microscopical Society," and was suggested by Mr. Geo. Davis, of Heaton Chapel. It is arranged to fit over the object-glass, and screw into the body of the Microscope.

Fig. 6.

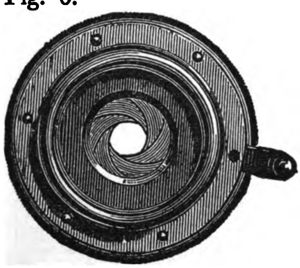


Fig. 7.

By this appliance an objective of large angle can be used for objects with depth, and great penetration obtained by simply reducing the diameter of aperture. Its usefulness is still further increased by an adapter for fitting the same under the stage, in place of the ordinary wheel of diaphragms. Mr. Collins, of 157, Gt. Portland Street, London, is the maker.

To the Editor of the Journal of the Postal Microscopical Society.

SIR,—

As a Microscope suitable for class demonstration, I would recommend an instrument represented by annexed wood-cuts, and made by J. Parkes and Son, Birmingham, at a very moderate cost. As shewn in Fig. 8, it may be used as an ordinary table

Fig. 8.

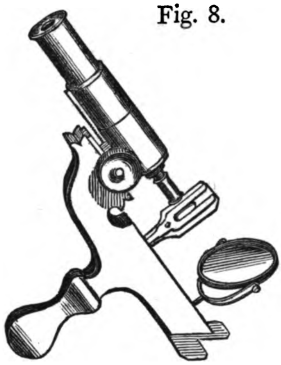
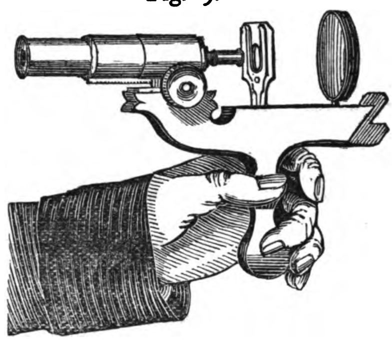


Fig. 9.



Microscope; or, with condenser substituted in place of mirror, as in Fig. 9, the Microscope may be held up to the light, and passed round from hand to hand. The object is firmly fixed on the stage by means of two flexible clips. The body has rack adjustment, and is furnished with standard Microscopic screw.

Yours truly,

THOMAS BOLTON,

Microscopists' and Naturalists' Studio,

57, Newhall Street, Birmingham.

Reports of Societies.

We shall be glad if Secretaries will send us Notices of the Meetings of their Societies. Short abstracts of Papers read, and principal Objects exhibited, will always be acceptable.

BATH MICROSCOPICAL SOCIETY.

A general meeting of the Bath Microscopical Society was held at

the Mineral Water Hospital, on Tuesday evening, Feb. 7, the President in the chair.—Mr. A. Pitman was unanimously elected a member of the Society.—After the reading of the minutes the President referred to the great loss which the Society had sustained since its last general meeting by the death of Mr. Charles Moore, F.G.S., who was one of its original founders. He thereupon moved a vote of condolence to the widow of their deceased fellow-member, which was seconded and carried. The President (Rev. E. T. Stubbs, M.A.) read the paper of the evening on "A species of Lepeophthirus," which he found in the Aquarium at Brighton upon a Bass. The species is apparently hitherto unknown. The history of the Lepeophthirus, a genus of the Crustacea, was sketched in an interesting way, and it was described as a creature which, among many others, is formed not to fill a spot in the world unoccupied or untenanted, but to live and multiply upon the bodies of other animals. Such creatures, known as parasites, form not at all an inconsiderable class among living beings, and many of them are tenanted by other and smaller parasites. The specimen he was describing had been handed to him by the courteous manager of the Brighton Aquarium in August last. It was found by him on the Bass, one of the fishes of the Perch family, and since then Mr. Stubbs had found a very similar creature on the John Dory. He had no doubt that the parasite belonged to the genus Lepeophthirus, of which there are at present six or seven species, the largest being the one frequently found on the salmon, *L. Stromii.* The paper entered fully into the history and anatomy of these curious creatures, and was accompanied by some excellent drawings and a large collection of slides.—A discussion followed the reading of the paper, and Mr. Braham referred to the theory of deterioration in the limbs of parasites, consequent upon their inaction.—A cordial vote of thanks was given to the President for his instructive paper.

THE Bath Microscopical Society held a general meeting on Tuesday, March 7th, the President, the Rev. E. T. Stubbs, being in the chair. Arrangements were made for searching the canal for fresh water life, to be exhibited by several members on the next club evening. Mr. Alfred Allen, one of the Vice-Presidents, read a paper on "Legs of Insects," accompanied by several novel diagrams, in which, by the use of red discs, the remarkable variety of position was shown which these organs occupy in the several orders of the insects. The locomotive organs from the larval state to the condition of the perfect insect were interestingly

described, although it was clearly shown that many apodal larvæ move without legs. To some, these organs would be a comparative hindrance to locomotion, because their natural requirements in seeking for food only occasion slight differences in situation and posture: the tubercular legs of many were well described, and attention called to the Rose Aphis with its six rows of tubercles, containing seven homogeneous legs in each row, with a total of 42 for the creature's use. The position of some of these legs is very curious. Reaumur describes legs on the top of the backs of certain insects. There is the grub of a little gall fly, found upon the under side of oak leaves, which has upon the middle of each segment of its upper surface a retractile fleshy protuberance resembling the spurious or pro-legs of a caterpillar. The position is an admirable provision for the creature's wants in the peculiar spherical home which it inhabits upon the under side of leaves. The next portion of the paper described the pedate larvæ which move by proper or articulated legs in distinction from those before mentioned, and the remainder of the paper was occupied by describing the legs and feet of the perfect insects. Numerous slides were exhibited to illustrate the subject, and a cordial vote of thanks was tendered to Mr. Allen for the reading of the paper.

Correspondence.

The Editors do not hold themselves responsible for the opinions or statements of their Correspondents.

To the Editor of the Journal of the Postal Microscopical Society.

SIR,—

I should much like to learn the opinions of my brother members on the subject of Microscope Demonstrations, when there are 30 or 40 people to whom objects are to be shown by these instruments.

On the other hand I have collected much information on projecting Microscopic objects on a screen, which I shall embody in one or two papers, if the members will care to have it.

CAREY P. COOMBS.

[We shall be very glad to insert Dr. Coombs' Paper.—*Ed.*]

SIR,—

Perhaps some of our members can offer suggestions as to a Microscope suitable for class demonstrations. I want to meet with a really useful, portable instrument, which can be passed round to individual students during class instruction. The arrangement must admit of the perfect safety of the slide, and also allow the object to be fully illuminated. The instrument referred to by Dr. L. Beale in his work on the Microscope, is, from what I can gather, of a costly nature; what I require is an instrument of reasonable cost.

WM. NARRAMORE,

Liverpool.

[Our correspondent will find an instrument described on page 52, that may probably meet his requirements.—*Ed.*]

To the Editor of "The Journal of the Postal Microscopical Society."

SIR,—

I should like to suggest that in an early number of this Journal a short description of "How to take a Photograph of minute organisms" be given. Many a subscriber who is not able to give a correct drawing might be able to furnish a Photograph. The description should be as short and clear as possible.

Yours truly,

J. SMITH.

[Other correspondents have made a similar request.—*Ed.*]

A correspondent writes to us, asking for information as to the "best and simplest mode of separating such minute objects as Spicules of Gongonia and Sponge, Plates of Holothuriæ, Starch-granules, etc., from the dirt and *debris* with which they are always mixed up, and obtaining them in a clean state, ready for mounting." He cannot find the process explained in any of the ordinary text-books, and attempts made to solve the difficulty have hitherto ended in failure.—*Ed.*

EXCHANGES.

Notices are inserted in this column free of charge:—they should not exceed five lines in length, and must reach us at least 3 weeks before date of publication.

Works on Geology and Mineralogy, Fossils and Minerals, wanted in exchange for works in General Literature, and good Photographs of European and American Scenery.—J. C. Christie, Old Cathcart, Glasgow.

Wanted—Fronds of Hot-house Ferns *with Sori*, for Microscopic Mounting. List on application.—Miss E. Jarrett, Cameron Court, Bath.

Parasite of Cat. *Trichodectes subrostratus*, Hæmatopinus from Rat, and many others, offered for similar objects. Braula and Stylops of Bee, Hæmatopinus of Seal and Sea-Lion especially desired. Please send list to H. E. Freeman, 1, Templeton Road, Finsbury Park, N.

A few good mounts of Horn and Hoof Sections, Diatoms, etc., also various interesting, named, unmounted Objects, in exchange for well-mounted Slides.—Chas. J. Watkins, Kings' Mill House, Painswick.

Beale's "How to Work with Microscope," fourth edition, as good as new, in Exchange for Beale's "Microscope in Medicine," name edition.—Dr. Coombs, Castle-Cary.

Well-mounted Sections of the Generative Organs of Dog and Monkey, and other anatomical objects, for good slides of Foraminifera, Vegetable Tissues, Algæ, Fungi, etc.—Wm. Narramore, 87, Flaxman Street, Liverpool.

I shall be happy to exchange lists of Duplicates with any member; objects chiefly simple vegetable.—G. B. Mundy, Warminster, Wilts.

Wanted, during the summer, specimens of the less common *Diptera*, freshly killed in spirit, in exchange for good botanical and entomological slides. —J. H. G., 15, Prior-Park Buildings, Bath.

SALE COLUMN.

Advertisements by members and subscribers are inserted here at the rate of Sixpence *for 20 words, and* Threepence *for every additional 10 words, or portions of 10.*

Dealers' and Trade Advertisements are inserted only on the cover, and at special rates.

All Advertisements should be sent to the Editor, 1, Cambridge Place, Bath, at least 3 weeks before the date of publication.

Microscopic Objects for Mounting. Fifty preparations, accurately named, 2/6.—R. Philip, 4, Grove Street, Stepney, Hull.

For Sale, or Exchange for Microscopic Slides, Natural History Works, etc., a fine-toned Violin, in capital condition, with case for same, etc.—J. E. Priestly, Abbey House School, Tewkesbury.

Wanted—Journal of the Royal Microscopical Society, vol. I. 1878; Knowledge, nos. 1 and 2, November 11 and 18, 1881.—A. Allen, 1, Cambridge Place, Bath.

NOTICES TO CORRESPONDENTS.

All communications should be addressed to "Editor," care of Mr. A. Allen, 1, Cambridge Place, Bath. They must be accompanied by the name and address of the writers, but not necessarily for publication.

G. D.—Thanks for your interesting "Ramble;" no room for it in present issue.

J. S.—Your short paper on Carboniferous Holothuriæ in our next.

T. P.—The papers from you shall have our careful consideration.

W. H.—One of your most interesting papers will appear in our next.

G. B. M.—Thanks for your letter; we fear your suggestion will interfere with the efficient working of the Journal.

F. M.—Early attention shall be given to your paper; it will need some little revision.

Dr. C.—"Section Cutting" in our next.

Sigma.—The contents of your paper not very suitable.

The Journal

OF THE

Postal Microscopical Society.

JUNE, 1882.

On a supposed New Species of Caligus.

BY THE REV. E. T. STUBBS, M.A.

Plate 6.

LAST August there were given to me by the kind and intelligent Manager of the Brighton Aquarium, several living specimens of a parasite which he had found upon a Bass in one of the tanks, and which appear to me to have been hitherto unknown, or at least undescribed. I found afterwards a large number of the same parasite upon a John Dory, in the same aquarium, and thus had a good opportunity of studying closely and minutely their structure.

There is a group of Entomostraca, chiefly, if not altogether, marine, of the order *Siphonostomata*, called so, as the name implies, from the shape of the mouth; the genus *Caligidæ* belongs to this order, and includes, according to Baird, four sub-genera,—Caligus, Trebius, Chalimus, and Lepeoptheirus.

The mouth in this order is extremely singular in its arrangement and appendages, and in the subjoined plate (Figs. 1 and 2) is seen situated, both in the male and female, on the under side of the cephalothorax, between the first or anterior pair of feet;

in the living specimen it could be seen moving slightly, with a sort of contractile motion. In *Lepeoptheirus Stromii*, which is the largest of this kind, the siphon-mouth can more readily be seen; it is shown in Fig. 3 magnified 200 diam., and is seen to consist of a sac surrounded by three muscles, arranged transversely, and having also two longitudinal muscles, by which apparently the process of suction is carried on. This sac is terminated by a very curious mouth, armed with twenty-four curved teeth, arranged in two quarter-circles, and diminishing in size in opposite directions from a point in front. A separate sketch of this mouth, greatly magnified, is given in Fig. 4. Behind the mouth, but connected with the sac above mentioned, is a proboscis, having its inner and anterior extremity shaped like a funnel, and the external end, which projects beyond the mouth, terminated by a sucking-disc or gland, not unlike the extremity of the proboscis of a humble-bee. I have little doubt that this description will also serve in the main for that of the siphon-mouth in the other sub-genera.

When I became possessed of the living specimens from the Bass, I found that they were themselves encrusted with other and smaller parasites of three different kinds—principally *Apoda*, and of the species *Nephilis*—which in one example clustered so thickly upon the *Caligus* as to conceal its configuration altogether.

In Figs. 1 and 2, sketches are given of the underside of the male and female *Caligus*, which will be found to differ from each other in some curious and interesting particulars. The body is flat, having its upper surface convex and the under surface concave. On the anterior extremity of the cephalothorax are to be seen two lunules, or sucking-discs, situated close to the edge of the carapace; they are oval, and for two-thirds of the hinder part of the curve have a double-ridged border more elevated than the front portion—they are apparently not used for walking, as is the case with those of the *Argulus foliaceus*.

There are six pairs of legs attached to the under surface of the carapace. The first pair are small, and terminate with claws or hooks not unlike those of a crab; the second pair are very large and powerful in the male, but smaller in the female, and are evidently designed for holding the prey firmly. The third and fourth pairs are long, slender, and slightly hooked; the fifth pair

are adapted for swimming; and the sixth and last pair are long (longer and more powerful in the male than in the female), and in both they are furnished with claws, five in number.

The swimming-apparatus is exceedingly elaborate in its structure, and consists of two sets of plumose setæ, eleven in number, placed at each side of the head behind the lunules, and in front of two long antennæ, which project at almost right angles from the median line. The fifth pair of legs already mentioned form also part of the swimming-mechanism. These legs have each a strong tarsus, and upon this are articulated two joints, short, and nearly at right angles to each other; one furnished with eight long plumose setæ, the other provided similarly with seven. Ranged immediately behind, quite on the posterior edge of the carapace and projecting backwards, there are, on each side, two pairs of semi-circular flap-like swimming-plates, also plumose and capable of motion.

The female has a larger abdomen than the male, and in it are to be detected convolutions of what appear very much like eggs in the ovaries. There is a double tail, having at each extremity three long plumose setæ, not unlike the double tail of *Cyclops quadricornis*.

The eye, Fig. 5, is placed on the upper side of the cephalothorax, in the median line, and just opposite to the mouth, which is, as already stated, on the under side. On careful examination with the quarter-inch, the eye is found to be double, composed of two lenses placed back to back, separated by a comparatively wide septum, and thus capable of looking in opposite directions.

It is not unlikely that, as is the case with *Cyclops* and some of the Entomostraca, the respiration is anal; and when the living animal is viewed in a favourable light, a movement corresponding to such respiration may be detected.

The female bears two ovisacs at each side of the tail, in which the eggs may be seen closely packed together: they are long, narrow, and transparent; very easily detached, and about as long as the creature itself.

The cephalothorax is fringed all round with a very finely striated, gelatinous fin, of such exceeding tenuity that it almost disappears from view when traced along from the front, where it is

thicker, towards the propulsion feet. A fin somewhat similar but much smaller is seen at the anterior extremity of the carapace, between the two lunules.

The upper side of the cephalothorax appears to be composed of nine plates of shell; at least there are depressions which would seem to indicate that the shell is separated into that number of parts.

At first it was concluded that this was a species of *Lepeoptheirus;* but from the presence of the two lunules, or sucking-discs, which I believe only the *Caligus* has, it must belong to the latter species.

The fish upon which these *Caligi* were discovered did not appear to be in the slightest degree discomposed by their presence; neither did they seem to inflict any injury upon their host, or even to attach themselves permanently to any one special spot or portion of his body; but just to move about with greater or less briskness as humour or accident dictated.

What purpose in the economy of Nature such creatures can serve is very mysterious. For these, the *Caligi* and *Lepioptheiri* especially, are not found on unhealthy fish, but are rather proofs of good condition and vigour. The indications of disease are shewn by quite a different class of living things—by other species of parasites quite unlike these, and by various kinds of fungoid growth;—but the fact that a condition of health, sound constitution, and perfect vigour should be indicated by the necessary presence of any sort of parasitical animals, is a mystery in nature which remains yet unsolved.

EXPLANATION OF PLATE 6.

Fig. 1.—Female Caligus, undescribed species.
Fig. 2.—Male ditto ditto.
Fig. 3.—Mouth-organs of Lepeoptheirus Stromii; general view, × 200.
Fig. 4.—Recurved teeth in mouth, more highly magnified.
Fig. 5.—Eye of Caligus, with double lens.

Cutting Sections of Soft Tissues.

By C. P. Coombs, M.D., Lond.

THE people who cut Sections of granite, coal, bones, teeth, and the like, are to my mind worthy of much honour; but I do not feel disposed to follow their lead. The soft tissues are troublesome enough at times, and impracticable always, unless properly hardened;—but the intermediate tissues, such as most vegetable structures, are fairly manageable when a section-cutter is employed;—they are in the province of the double- and treble-staining people, and to these I would rather leave them, hoping that we shall have a paper on the preparation of these most attractive objects. This paper refers merely to the best modes of cutting soft animal tissues; the first and readiest of these being by preparatory freezing. Ice and salt have been largely used for this purpose, but the ether-spray apparatus has latterly taken the place of this mixture, and is employed in the arrangements now to be described. The simplest apparatus with which I am acquainted, is a solid cylinder of copper, an inch long, and about ¾-inch in diameter, fitted on a cylinder of wood with a foot. "A tube of wood is made to fit outside the copper cylinder, and to slide back over the handle. This tube acts as a guard in preventing the contact of the warm fingers with the copper, while the section is being made. To use the instrument the ether spray is directed against the metal until a white floss covers it,—the guard is then slid up, and a piece of the tissue to be examined is laid on the rough surface of the copper. A drop of water or serum is now let fall on the tissue, and in a few seconds both fluid and tissue are frozen sufficiently for cutting purposes." This description of his instrument is given by the inventor, Mr. Coppinger, of Dublin.

Dr. Rutherford's Microtome is similar in principle, but is more elaborate. It has a large cutting plate on which the knife or razor is made to slide; the copper table on which the frozen tissue rests is propelled by a screw which has a very fine thread, and the ether spray is thrown up from beneath into a hollow in the copper, which is so made that the surplus ether can be collected. This clever instrument has many advantages, besides the one (common to all freezing microtomes) of enabling the pathologist

to examine tissues without delay. Dr. Lockhart Clarke made his sections of brain and spinal cord in the following manner. It is an interesting contrast to the freezing method just described:—The tissue is cut into fragments of moderate size, which are first soaked for 24 hours in a fluid composed of equal parts of alcohol and water, then for 24 hours in pure alcohol. Then the pieces are immersed in dilute Chromic Acid (straw coloured), or solution of Potassium Bichromate in water (1 to 200), for some *weeks*, or until they are found hard enough to be cut. The sections are rendered transparent by soaking them in turpentine, if necessary.

Now I proceed to the plan devised by Dr. Klein, or some of the German Histologists, for cutting sections without apparatus. The tissue must first be hardened by the method of procedure just described, or by soaking in methylated spirit only, which is sufficient for most animal structures; others do better when steeped in a one or two per cent. aqueous solution of Potassium Bichromate. In either case several days of soaking are required before the tissue can be cut; but supposing that a fragment has been rendered firm enough by one of the methods given, it is to be mounted in wax as follows:—

White wax is melted with about one-fourth of its weight of olive oil in a porcelain dish, and the two are well mixed together. When cool, the wax should be cut with a razor to try its consistency, and if it is hard enough to cut into very thin slices without breaking, it will do. Then a little paper or cardboard trough is made, (about 1½-inch long, ½ an inch deep, and the same broad,) and set on a firm and level surface,—the wax is melted by holding the porcelain dish over a lamp,—and poured into the trough till three-quarters full. Now thrust a fine needle into the piece of tissue to be cut—which should be a cube about one-sixth inch each way—and dip the tissue into the melted wax;—take it out and hold it in the air to cool;—then dip again, holding it up as before, and repeating the process until it is well coated; then hold it in the middle of the trough till the wax begins to set, and fill up the trough with more melted wax. When the whole is cool, strip off the paper mould; and cutting away the wax until the imbedded tissue appears, slice tissue and wax together with a thin razor dipped in spirit. The slices are to be taken off the razor while it is immersed in spirit, as, if thin enough, they are very fragile. (Before describing the mounting, it will be as well to say that the "Army Razor," sold by Messrs. Arnold, of Smithfield, is well adapted for section cutting, as it has a very thin and wide blade.)

The sections which appear eligible having been selected, they are next to be taken from the methylated spirit on a flat instrument, and deposited in clear spirit first, and then in the staining

fluid. If, however, the tissue has been hardened in Bichromate, or in Chromic Acid, they must go into a solution of Carbonate of Soda, before staining.

Hæmatoxylin stain is made by boiling

Extract of Hæmatoxylon ...	...	1 part;
Alum	...	3 parts;
Water	...	40 „

filtering when cold, and adding to this fluid methylated spirit 5 or 6 parts. This stain has some advantages over that made with carmine, but ink is a very fair substitute for either.

Watch-glasses for holding the sections in the various re-agents, viz:—methylated spirit,—clear spirit,—the staining fluid suitably diluted with water,—absolute alcohol, and lastly, oil of cloves, should be arranged on the table in the proper order, so that the sections may be lifted from one to the other—after remaining a few minutes in each. Finally, the section is taken on the lifting instrument from the oil of cloves, allowed to rest for a few seconds on some blotting-paper, then laid on the centre of a glass slide, and covered with a thin glass circle, bearing a drop of the mounting medium. Dammar varnish—or balsam softened with chloroform—will be found the best for objects prepared as above described.

Spiders: Their Structure and Habits.

By William Horner.

FIRST PAPER.—Plate 7.

I PROPOSE in this paper, after saying a few preliminary words on the class ARACHNIDA, to take up more particularly one of its main divisions—*Araneidæ;* and to consider the structure, economy, and habits of the animals which compose it, illustrating these by reference to some of the more remarkable British species.

The ARACHNIDA are a class of ANNULOSA, closely allied to the Crustacea, and include Spiders, Scorpions, Mites, etc. The body is divided into segments, or somites, and is furnished with four pairs of legs.

There are two divisions of the ARACHNIDA:—(1) *Trachearia*, in

which respiration is cutaneous—*i.e.*, by the general surface of the body,—or else by tracheæ, which are air-tubes, opening on the surface of the body by stigmata, or spiracles, and branching freely as they penetrate the interior. The eyes in this division never exceed four. (2) *Pulmonaria*, in which respiration is by pulmonary sacs alone, or by these and tracheæ conjointly, and the eyes are generally six or eight in number.

To the former division belong the Sea-Spiders or *Podosomata*, Mites or *Acari*, and *Phalangidæ* or Harvest-Spiders, distinguished by the length of their legs.

To the latter belong the higher *Arachnida*, as Scorpions and Spiders. The Scorpions are possessed of a segmented abdomen terminating in a hooked claw, perforated at its point by the duct of a poison-gland which lies at its base. There is no line of demarcation between the abdomen and cephalothorax, and they have strong nipping-claws, or chelæ.

The *Araneidæ*, or true Spiders, (called also *Dimerosomata*, from their bodies showing two distinct divisions), are characterized by the union of head and thorax into one mass, which is named the cephalothorax, and by a soft unsegmented abdomen attached to the former by a peduncle. They breathe by pulmonary sacs in combination with tracheæ. The head bears 2, 4, 6, or 8 simple eyes; they have no chelate limbs, and their abdomen terminates with a spinning-apparatus instead of a sting. These are the principal points of difference between Scorpions and Spiders.

In treating of these latter, it will be best to commence with the internal structure, as it is by this, rather than by outward form, that the divisions of the animal kingdom are ruled.

Spiders possess a system of circulation and respiration distinguishing them from insects, and giving them a higher rank in the scale of creation. The blood is colourless, and like that of fishes holds in suspension oval corpuscles. The heart is a long muscular vessel, placed lengthwise in the upper part of the abdomen, enclosed in a pericardium, and having four chambers. An artery runs through the peduncle, separating in the cephalothorax into three pairs: of which the upper pair sends off vessels to the eyes and mouth, the middle pair to the digestive organs, and the third to the legs. These arteries re-unite in the forepart of the cephalothorax, and form one canal, which runs backwards along the lower part of it, and of the abdomen, to the spinning-organs, sending out small branches on its way (Plate 7, Fig. 1). The blood is then passed on through channels analogous to veins into receptacles communicating with the breathing-organs, where it is oxygenised, and so returns to the heart.

The pulmonary sacs, or gills, two in number, are involutions

of the integument, or skin, of the abdomen; the vascular surface thus formed being increased by the development of 50 or 60 thin triangular white leaflets, like the leaves of a book, all opening into a common cavity, and communicating with the external air by a pair of stigmata visible on the under-surface of the abdomen, near its base. In the envelope of these gills is a tough ligament which is attached to the pericardium; consequently, the dilatation and contraction of the heart alternately close and open the gills, and by this simple arrangement respiration is effected.

The stomach is situated in the cephalothorax, receiving food from the mouth through an œsophagus, and discharging its contents through a tube, or alimentary canal, running down the abdomen into the rectum at its extremity.

Passing now to the outward structure of the spiders, we commence with the cephalothorax, the upper side of which is called the shield, and has attached to it the eyes and the falces; the lower side goes by the name of the breastplate, and is connected with the mouth, the palpi, and the legs (Plate 7, Fig. 8).

The eyes are simple, like the stemmata of insects, but in structure they bear some resemblance to the vertebrate type, although apparently fixed and inexpressive. To compensate for their immobility, they are disposed in several pairs in various parts of the forehead. Their mode of arrangement varies widely in the different genera, and affords one of the best generic characters: in the 8-eyed tribe they are often placed in two transverse rows on the forehead, but such is by no means always the case, as may be seen from the drawings in Plate 7, Figs. 2—4; in the 6-eyed tribe there is even greater variety of position, Figs. 5 and 6.

For seizing and disabling its prey, the spider is furnished with a pair of falces, which are very formidable instruments in proportion to their size: they are attached to the front edge of the cephalothorax above the jaws, and consist each of two joints. The lower joint, or base, is somewhat conical and fleshy; the upper, or fang, is horny and pointed, with an opening at the tip, through which a poison is conveyed from a gland in the basal joint. That this poison is an acid is proved by its reddening litmus paper, but it has no taste perceptible by the tongue; and a series of experiments, carefully conducted by Mr. Blackwall, appear to establish the conclusion that it produces no appreciable pain or inflammation upon the human subject; neither does it exhibit any high degree of virulence in its effects upon other spiders, or upon insects. This naturalist conjectures that upon insects it may have a tendency to paralyse their organs of voluntary motion, and induce a determination of their fluids to the injured part. The fang is attached to the base by a hinge-joint, and in most families with a vertical or inclined articulation,

allowing it to move inwards in a horizontal or inclined plane only. When not in use, the fang is folded upon a groove along the inner edge of the basal joint, which is furnished sometimes with a single, and sometimes with a double, row of teeth (Plate 7, Fig. 8).

Below the falces, and attached to the forepart of the breast-plate, are the external organs of the mouth: these comprise a pair of maxillæ, or jaws, each bearing a long, five-jointed palpus,—and an under and upper lip, the latter scarcely visible. The palpi project from the jaws on either side of the falces, and have each five joints covered with hairs and spines, and named respectively the axillary joint, which is short; the humeral, which is long; the cubital, short; the radial, long in the female, but short in the male; and lastly the digital. In the female they strongly resemble the legs, and taper towards the extremities, which are armed with a single claw, toothed like a comb. In the male the fifth, or digital, joint is much dilated, and has no claw, but instead, a complicated set of soft membranous parts, ascertained by the patient observations of Mr. Blackwall to constitute the sexual organs. They are fully developed in the adult male only, and afford the readiest means of distinguishing the sexes (Figs. 9, 10, 11).

The legs are attached to the breast-plate, and consist each of seven joints of very different lengths. The seventh joint, called the tarsus, is terminated by two or more claws, usually curved and toothed like a comb; the number of these claws varying according to the habits and requirements of the family. The absolute and relative lengths of the legs also vary greatly, and afford useful generic and specific characters.

The abdomen is unsegmented, and is enveloped in a soft, continuous skin, covered more or less densely with hairs. Its upper surface, in the out-of-door species, is often variously painted. At its extremity are the spinning-organs, consisting of three pairs of mammulæ, or spinnerets, in every British family except one—that of the *Ciniflonidæ*,—which has four pairs. They are distinguished as the upper, lower, and intermediate pairs. The upper pair have each two, and occasionally three, joints; the lower pair have two, and the intermediate pair but one joint. Each of these spinnerets is furnished, at its extremity, or along the under surface of the terminal joint, with fine moveable papillæ, or spinning-tubes, communicating by ducts with a series of internal glands. These secrete a liquid gum, which on issuing from the tubes hardens immediately by exposure to the air, and forms numerous very delicate filaments. To produce the finest possible lines, the spider employs the spinning-tubes separately; but if stouter lines are required she causes the tips of the tubes

to converge into a point like the vertex of a cone, and so spins an entire thread composed of a multitude of strands. The threads so spun are not all alike. If we examine the web of a garden-spider (*Epeira*) with a good pocket-lens, we find it composed of three different kinds of threads. Two of them are plain and differ only in size; the third is studded with minute globules like dewdrops. It is also found that, while the plain threads are only slightly elastic and unadhesive, the beaded threads are adhesive and possess a high degree of elasticity.

With regard to the organs of smell and hearing nothing certain is known, although the fact that spiders possess the latter sense seems sufficiently established by many well-known anecdotes; as, for example, that of Pelisson, the prisoner in the Bastille, who beguiled his weary solitude by taming a spider, and teaching it to come for its food at the sound of his flute.

Such, then, with some allowance for slight deviations, or adaptations, is the structure of all spiders. We will now briefly consider their economy and habits; for, although all are endowed with the same organs and formed upon one type, these are often widely different. Some float in the air, some dive beneath the water; and of those which are tenants of the land, some are sedentary, some vagrant. Of the sedentary ones, some weave snares more or less curious and complex, and sit therein patiently waiting for clients; while others of more refined taste, instead of residing at their place of business, weave a silken gallery and connect it with their private residence at a convenient distance off. Some, again, are burrowers, and live in chambers excavated for themselves beneath the ground and comfortably lined with silk. Unsocial and ferocious in their habits, ugly and repulsive as they are commonly considered, and the abomination of tidy housewives, the only redeeming feature about them is the devotion of the female to the silken cocoon, in which are deposited her hopes of a family. Of conjugal affection she has none. Being larger and stronger than the male, she will not seldom even kill and devour her consort; and were it not for her fecundity, and capability of producing several sets of prolific eggs in succession, without renewing her marital intercourse, the race of spiders would long ago have become extinct.

But in spite of this cloud of obloquy, and the inveterate prejudice against them, they display an intelligence, an ingenuity, a patience, and a fertility of resource, that cannot fail to enlist the admiration and the interest of any one who will be at the pains to study them, or who (to adopt the words of John Hunter) will "amuse himself with spiders."

The next point to consider is their classification. British spiders are divided into two tribes:—the 8-eyed tribe, consisting

of ten families;—and the 6-eyed, which contains only two families. Of foreign spiders there are two tribes in addition to the above, namely, the 4-eyed and the 2-eyed; but of the 4-eyed tribe only two individuals, so far as I am aware, are known. One of these, the *Tetrablemma medioculatum*, was discovered by Mr. Thwaites in Ceylon in 1871, and a description of it is given in "The Proceedings of the Zoological Society for 1873." It bears no affinity to its fellow-tribesman; and the four eyes are closely grouped round a circular eminence in the centre of the cephalothorax—an adaptation rendered necessary by the conical shape of the latter.

The 2-eyed spiders are also very scarce, only a few species being known.

The 12 British families may be divided, like the Roman gladiators of old, into two classes:—the Retiarii and the Secutores, for six of them *ensnare* their prey by subtlety in webs of various descriptions, and six *pursue* their prey and capture it by swiftness of foot. Suppose we designate them the *Retiary* and the *Hunting* spiders, and see whether we can find any interesting members of either class.

The "Hunters" weave no snares, but hide under stones or leaves, or in crevices, whence they rush out upon passing insects, sometimes springing upon them from a distance and surprising them. Of these the *Lycosa* (wolfish) and the *Salticus* (leaper) are very common examples; and many of them may be found even in the winter months on sunny days in full activity.

The *Drassidæ* (seizers), although they weave no snares, construct silken cells for places of concealment, and in these they lie snugly ensconced through the winter, generally beneath the loose bark of rails or trees. The most remarkable members of this family are the Water-spiders, or more poetically and more classically the *Argyronetæ* (spinners of silver), from the beautiful silvery cell which they build on sub-aquatic plants, and which they fill with air brought down, a bubble at a time, from the surface, just as a glass jar is filled with gas on the shelf of a pneumatic trough. The Rev. J. G. Wood gives a charming description of these interesting little creatures in "Homes without Hands." They are so commonly met with in aquaria, of which they are among the most popular tenants, as to render any further description of their proceedings almost superfluous. One of the Wolf-spiders, the *Dolomedes fimbriatus*—the generic name signifying "crafty"—also frequents the water; not building a sub-aquatic home like the former, but leading a piratical life on the surface, cruising about on a raft of dead leaves and twigs bound together with cords of silk. It disembarks and runs along the surface of the water in pursuit of insects, and even descends beneath it, not by diving, like the *Argyroneta*, but by crawling

down the stems of plants. It is among the largest of British spiders, the female being nearly an inch long in the body; and it mostly inhabits fenny districts.

Beside these two species, it has been found by experiment that a few others, belonging to a distinct family—*Neriene longipalpis*, for example—will exist in a state of activity for several days submerged in water, spinning their lines and behaving all the time just as in air.

The feet of the Hunting-spiders are somewhat differently furnished from those of their Retiary brethren. Each foot has two claws and a scopula, or brush, designed like the tarsal cushions on the feet of flies and other insects, to enable them to run up polished surfaces, or to walk along them in an inverted position. The brush consists of a number of shafts springing from the base of the tarsus under the claws, slightly curved, slender at the base and expanded at the extremity. Each shaft is fringed with fine hairs, and its extremity on the under-side is covered with a multitude of hair-like papillæ, which not only give the animals a mechanical hold on smooth surfaces by the friction arising from so many points of contact,—amounting in a specimen of the *Mygale avicularia* to 400,000 on each foot,—but they also emit a viscid secretion which adheres to the surface with a tenacity sufficient to sustain their weight.

Some of the genus *Salticus* have been observed to use these brushes to wipe and polish the cornea of their two front eyes, which are unusually large and prominent.

The Burrowing Spiders afford good examples of ingenuity and perfection of workmanship in the construction of their habitations and snares. To this class belong some of the *Agelenæ* (foragers); and one species, the *A. labyrinthica*, is common enough on open banks where the herbage is coarse and the surface irregular. It spins a horizontal web of a compact texture, and fabricates a tube of white silk conducting to, or serving for, its retreat; at the mouth of this it watches, and yet is not easily captured; for it pops into the tube and disappears on the slightest alarm. It is readily distinguished by the length of its spinnerets, the upper pair being three-jointed, and projecting far beyond the others; while the spinning-tubes are placed in a row along the under surface of the terminal joint. When we come to examine closely the silken tube woven by this spider, we discover a cause for their unusual length. It is a compact tissue impervious to the smallest grains of sand, and made by a process analogous to that of weaving. Instead of the tips of the spinning-tubes being brought to meet in a point, as when a strong thread is to be spun, the tubes of the lower pair of spinnerets are erected so as to be brought parallel to each other, and thus a band of fine parallel filaments is

produced, forming the warp; as these are being drawn out the spinning-tubes of the long upper pair are similarly manipulated to prepare the woof, which by an alternate lateral movement of the joints is bound down upon, and across the warp. This process is repeated until the web has acquired the necessary toughness and compactness.

The best example of British Burrowing Spiders is that very rare species of the *Mygalidæ*, and the only one found in Britain, the *Atypus Sulzeri*, (Plate 7, Fig. 7,) which means by interpretation the mis-shapen one. It loves sandy places, where it excavates for its abode a cylindrical hole half an inch in diameter, in a direction sloping downwards. To keep out the sand it lines this hole with a tube of white silk of compact tissue, protecting the entrance by a flap of the same material, and for this purpose it is furnished with a prominent pair of spinnerets like the *Agelena labyrinthica*. This is the only kind of spider that has the fangs of its falces articulated horizontally, so as to give them a vertical movement. They are very formidable weapons, and so gigantic in size that the owner would be unable to see over them but for an adaptation of the cephalothorax to meet the emergency. It carries in its forepart a protuberance or turret, and on the summit of this the eyes are planted in four pairs.

From a friend I recently received an interesting communication relative to this solitary British species of trap-door spiders. He informs me that a few days before he had dug out the nest of an *Atypus*, in the vicinity of London. The tube was 10 inches long, and at the bottom was the female surrounded by her numerous progeny, 157 in number. The male was not at home.

But the cleverest of all the Burrowing Spiders is the Trap-door Spider of Jamaica, who lines her subterranean gallery with a fine silken tube enclosed in one of a coarser texture. The flap at the mouth of this double tube is neatly finished off with a hinge, and is so contrived as to open outwards only, and to close by its own weight when left alone, concealing all traces of the burrow, the outer surface being covered with earth. Specimens of these nests are preserved in the British Museum.

EXPLANATION OF PLATE VII.

Fig. 1.—Circulatory system of Spider. *a.*, The 4-chambered heart, inclosed in a pericardium, and sending off arterial branches into the cephalothorax; *b.*, the gills in which the blood is aerated before it returns to the pericardium through 4 large vessels, as shewn.

Fig. 2.—Eyes of *Lycosa andrenivora.*
,, 3.— ,, *Agelena Hyndmanii.*
,, 4.— ,, *Walckenaëra acuminata* ♂.
,, 5.— ,, *Dysdera Hombergii.*
,, 6.— ,, *Scytodes thoracica.*
,, 7.—Profile view of *Atypus Sulzeri* ♀.
,, 8.—Falces and cephalothorax of *Tetragnatha extensa* ♀, viewed from beneath.
,, 9.—Male Palpus of *Atypus Sulzeri.*
,, 10.— ,, of *Salticus scenicus.*
,, 11.—Palpus of *Epeira diadema* ♂, under side.

(To be continued.)

Holothurian Plates from the Carboniferous Strata of the West of Scotland.

By J. Smith.

Fig. 10.

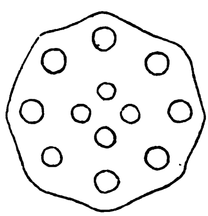
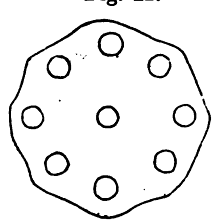


Fig. 11.

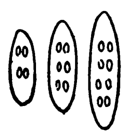
Fig. 12.



IN Messrs. Armstrong, Young, and Robertson's "Catalogue of the Western Scottish Fossils," under the head of "Echinodermata," on page 41, occurs the following note:—"In washing the limestone-shales from one or two localities (not given), small, microscopic, perforated, wheel-like organisms have been found, that are, provisionally, referred by Mr. R. Ethridge, jun., to the Holothuridæ." In examining under the microscope a quantity of the washed shale from Orchard Quarry, near Glasgow, I found a considerable number of "perforated, wheel-like organisms," which, I believe, are identical with those mentioned in the foregoing quotation. These little organisms measure about one

eighty-eighth part of an inch in diameter, and are roughly octagonal in outline. The upper surface is smooth, convex, and perforated with twelve small holes, four of these holes being near the centre, and eight placed at regular distances apart, just inside the margin (Fig. 10). The under-side is concave and smooth, with central boss, as shown in section (Fig. 11); and it has only nine perforations (Fig. 12), the reason for this being that the four central perforations of the upper surface join together (Fig. 11) before reaching the under side, and are there represented by one perforation only, placed in the middle of the central boss. These organisms are apparently composed of carbonate of lime, as they effervesce on the application of an acid. They still possess a dull whitish, pearly lustre. I searched the shale diligently, to see if I could meet with any anchor-shaped "feet," such as we find in connection with the plates of the recent *Synapta*, but nothing of that kind turned up. I have examined a long list of Scottish Carboniferous Shales, without finding any other specimens of these minute fossils, and I know of no recent organism that is at all like them. May they not be the ancient prototypes of the "wheels" of *Myriotrochus?* A slide of unnamed Holothurian Plates from Corsica, in my possession, shews three kinds of oval plates, perforated by four, six, and eight ovoid holes respectively; see Fig. 13. They are all very much smaller than the Carboniferous species.

Fig. 13.



In examining the Orchard Shale, I came across about a dozen of these fossils all massed together, which indicates clearly that to whatever organism they belonged they must have existed in considerable numbers. On first seeing them, I thought they might be diatoms, but their calcareous nature excludes this idea. That they had been embedded in truly marine strata, is clearly indicated by the fossils which were found accompanying them:—such, *e.g.*, as *Platycrinus*, *Griffithides*, *Dithrocaris*, *Fenestella*, *Productus*, *Spirifera*, *Lingula*, etc. I have named this Carboniferous Holothurian *Trochopalæus* (ancient wheel) *Youngianus*, after Mr. John Young, of the Hunterian Museum, Glasgow, who, I believe, was the first to find it.

Hydrozoa and Polyzoa.

BY DR. G. D. BROWN, PRESIDENT.

IN giving a short account of these, it is necessary to state that while specimens of each of the above classes have certain points of agreement, which will be spoken of presently, the two classes are so different in their anatomical structure that there is really a nearer relation between a dog and a fish than between one of the Hydrozoa and one of the Polyzoa. Thus, while the Polyzoa are comparatively highly organized, and somewhat complicated in structure, forming a division of the sub-kingdom Mollusca, which comes next below the sub-kingdom Vertebrata,—having a mouth to take in food, with œsophagus, stomach, and intestine, a separate aperture for the getting rid of undigested matter, and nervous and reproductive systems; the other class with which we propose to contrast them, namely, the Hydrozoa or Hydroida, has a much simpler structure, and occupies a far lower position in the animal kingdom. It belongs to the sub-kingdom *Cœlenterata*, of which it is the first class; the second class being the Actinozoa, or corals, sea-anemones, etc. There are two other sub-kingdoms, namely, that which includes the Radiata, consisting principally of the sea-urchins, star-fishes, etc., and one next higher than this, which contains the worms, the crustacea, and the insects; all these are placed below the Polyzoa, or Bryozoa, as the class is generally named by most continental authorities.

The Hydrozoa, then, or Hydroida, like the Actinozoa, which include the corals, sea-anemones, and others, have a most simple structure, such as many of us have seen in the sea-anemone, or the common *Hydra* of our ponds and ditches. In these cases, each is a distinct animal, and is a bag with only one orifice to receive the food,—this orifice being surrounded by a ring of tentacles which have the power of grasping, and often of paralyzing, the objects constituting its food, and bringing them into the mouth. After being swallowed, the undigested portions are returned by the way they entered. It appears to be a matter of indifference how these simple forms of Hydrozoa are treated. Turned inside out, what was before the outer skin acts very well as a digestive stomach, and if an individual be cut into pieces, each piece starts on its own account, and becomes an individual, perfect in all its parts.

These are the simple members of the class, but many others are compound, consisting of a stem with a sort of root, by which they attach themselves to stones, etc., and branches on which cells develop at intervals, each of these cells resembling the simple forms just described in having a mouth, stomach, and tentacles round the mouth, but differing in being all connected into a compound structure, through which circulates a fluid, formed and elaborated by such of the individual polyps (as the individual cells are called) as are in active life at any particular time. This common, connecting substance often develops on its outside a horny tissue, which firmly supports and holds together the delicate and soft substance forming the polyps, and being light, elastic, and strong, allows the waves to bend it gracefully backward and forward without injury. It is this horny or chitinous external skeleton which remains when life has departed from the organism.

It may be useful next to explain why animals so different in structure are often exhibited together, and thus many persons to whom they are new are led to confound the one with the other.

All the older authors, including Ellis, called them Zoophytes, or animal plants, not recognizing their anatomical differences, but judging from their external characters that they were all very nearly related; and even placing with them some vegetable growths called Corallines, which only bore the most superficial likeness.

What are known as Corallines are a family of Algæ which are stiffened by a deposition of chalk in their cells; but in the last century many of the Hydrozoa, and Polyzoa also, were called Corallines by Ellis, (whose work is dated 1755,) and by other writers also. Ellis's work gives most faithful descriptions and exact illustrations of these objects; and he has a happy way of naming in familiar English most of them—such as "Snake coralline," "Bull's horn coralline," "Goat's horn coralline," "Coat-of-mail coralline," etc. etc.

But while the forms of the compound *polypary* or *polyzoary* * bear a close resemblance one to the other, and while it is common to both classes to have tentacles round the orifice by which the food is admitted, there remain the important differences of structure previously described, and the fact that while both classes have tentacles, in the Hydrozoa the object of these tentacles is to grasp the food and bring it to the mouth, while in the Polyzoa the same end is gained in a very different manner. The tentacles of the latter do not seize the food, but while they

* *Polypary* is the term applied in the case of compound Hydrozoa, and *polyzoary* in the case of compound Polyzoa.

remain spread out in the form of an expanded ring, their surface is covered with cilia in ever active movement. These cilia create a perfect whirlpool, having the mouth as its centre, and any object small enough to be swallowed is brought in quite as effectually as by the less refined, and apparently more energetic, seizure by the tentacles of the Hydrozóa. As may be supposed, the tentacles of these latter do not possess cilia.

It remains to add that both classes, as well as being abundantly represented by living forms, are also found fossilized. The Hydrozoa have representatives as old as the lower Silurian. The Polyzoa also certainly date as far back as that, and possibly (if the *Oldhamia* belong to this class) as far as the Cambrian; but the exact zoological position of this interesting fossil is doubtful.

Coming to comparatively recent geological periods, one genus of Hydrozoa (viz., *Hydractinia*) still found living, has been observed in the chalk. Otherwise, Hydrozoa, common and varied as are their living forms, have not been found fossil. Perhaps this is because their skeletons are more perishable than those of the Polyzoa.

The skeletons of the other class, the Polyzoa, which are generally calcareous (or formed of chalk), are very numerous in the Devonian, Carboniferous, Permian, Triassic, Cretaceous (very abundant), and in the Miocene and Pliocene (as the Suffolk crag) very numerous. Some of the species found in the latter formation are identical with existing species; others of them have disappeared.

As regards recent and living forms of both classes, it is well to state that while there are a few Hydrozoa occurring in fresh water (as in the several species of *Hydra*), and also a few Polyzoa (belonging to a special sub-division of the class in which the tentacles are arranged in the form of a horse-shoe), yet the vastly greater portion of both classes are marine.

Photo-Micrography.

By Harry Barker.

Without some knowledge of the ordinary wet and dry photographic processes, it is utterly useless to attempt to photograph with the microscope. For to a SKILLED PHOTOGRAPHER the inherent difficulties can only be overcome by employing the best materials, adjusting the apparatus with the

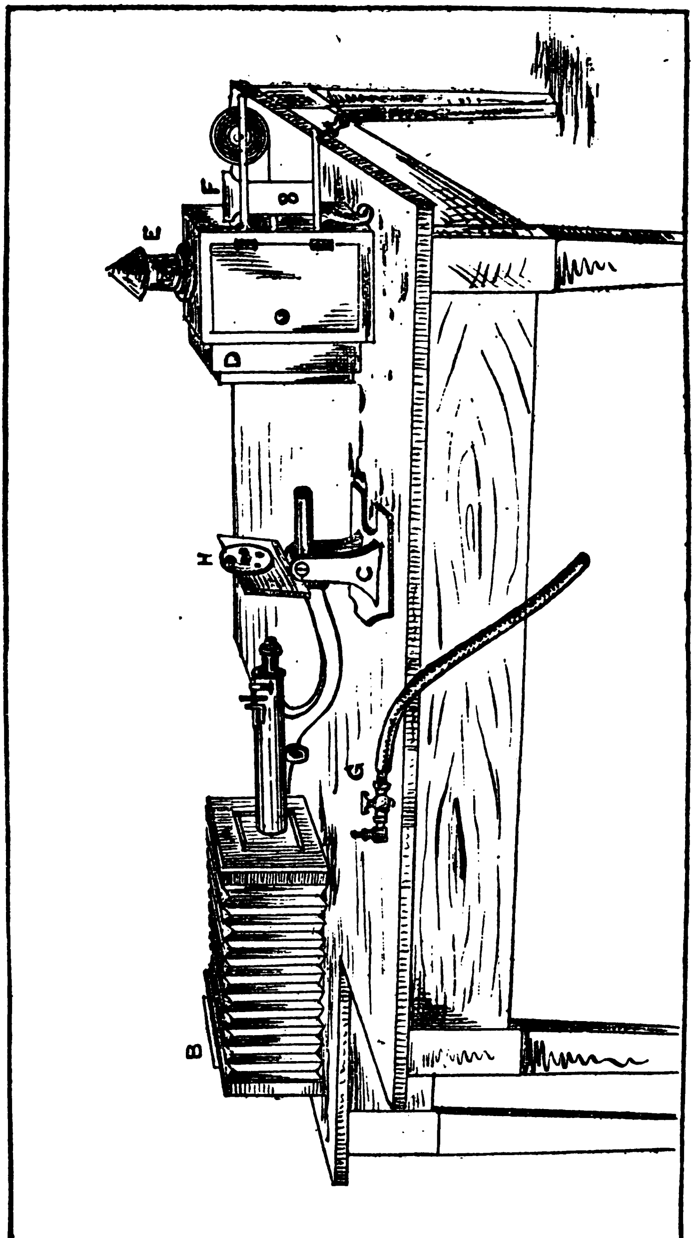
greatest care, and using abundant patience. I would, therefore (before detailing any plan of procedure), strongly urge microscopists who are entirely ignorant of the photographic art, to practise the ordinary wet-collodion process until they have acquired a practical knowledge of it; when they have advanced so far, and can judge correctly when a wet plate is properly exposed and developed, their next step must be to purchase two or three packets of Swan's dry plates, $4\frac{1}{4}$ in. by $3\frac{1}{4}$ in., and learn how to develop them. The best and quickest way of doing this would be to go to a photographer and take a few lessons.

Let us suppose the amateur has gone through these preliminary stages, and feels himself duly qualified to commence operations; I will next give a description of the various appliances required, and afterwards the mode of working. The illustration opposite shews the apparatus ready for use: it should stand on a strong table, the slightest vibration being an effectual bar to success.

A is the Camera; B, the dark slide; C, the Microscope;
D, the Condenser; E, a Lantern; F, a Magnesium-Lamp;
G, Gas-burner; H, Diaphragm.

The Camera, a bellows one, from four to five feet long, rests on a baseboard, which has a lath one inch high nailed on each edge, to prevent the Camera slipping from side to side when moved for focussing. This board should be at least two feet longer than the Camera, so as to hold the Microscope, Lantern, etc.; and the length of the Camera regulates the size of the picture, for as it is drawn out the picture increases, and *vice versa*. The microscope is an ordinary monocular one, with a draw-tube lined with black velvet to prevent central flare; and the eye-piece is removed. The coarse and fine adjustments should work well. For the benefit of those who have not penetrated into the mysteries of Photography, it is necessary to say that the visual and actinic foci of a lens generally lie in different planes; it would, therefore, be better to purchase a one-inch lens specially made for Photography, or a Woodward's amplifier, which would correct all objectives. However, if the amateur does not wish to incur more expense than is absolutely necessary, he must determine by experiment the actinic focus of the power he intends to work with; how to do this will be described further on.

The Lantern is made of tin or wood, and should be about 12 inches square (an ordinary wooden magic-lantern, or a Sciopticon, can be utilised): the condenser is fitted in the front, and a hole is made at the back for the nozzle of the lamp: the door must be kept closed when exposing. I have tried several means of illumination, and have been most successful with Solomon's


B
C
D
E
F
G
H

magnesium-lamp, placing it inside the Lantern instead of the oil-lamp. As the magnesium ribbon is expensive, I use a common fish-tail gas-burner to focus with, brought down into the Camera by an india-rubber tube; and when the image on the ground glass appears clear and sharp, I take it away and illumine with the lamp to see all is right before exposing.

If the microscopist works with a one-inch objective, there will be sufficient space between the front lens and the slide to allow a thin piece of wood, covered with black cotton wool, to be held against the lens as a cap; but if he is working with higher powers, the exposure must be effected by a mechanical contrivance sold for the purpose.

Having thus explained the various parts of the apparatus, the next thing will be to put them together and start to work. Great care must be taken to prevent any light being admitted into the Camera except that which passes through the lens; the part where the tube of the microscope fits into the front of the Camera should especially be seen to. The centres of the condenser and magnesium-lamp must also be exactly on a level with the objective. Do not use the focussing-screen belonging to the Camera, as it might not be quite in register, and it is not to be relied on for Photo-Micrography; but get a piece of very fine ground glass, the size of your plates, and put it into the carrier of the dark slide in the same way as you would the sensitive plate. The mounts selected must be very transparent,—preferably those mounted in glycerine jelly to those in canada balsam,—and quite free from dust or air-bells. Sections of wood, and the larger species of Algæ, are capital things to begin with. Place the slide to be photographed on the stage of the microscope; take a diaphragm a little larger than the object, so as to allow a margin all round, and fasten it at the back of the stage between the microscope and the condenser (it is shown in position in sketch); this will cut off any extraneous light from the lens. Light the gas, which should rest on a movable stand between the magnesium-lamp and the condenser, and begin to focus. A magnifying-glass should be used, and when the picture cannot be improved in sharpness, clamp the Camera to the baseboard. Then remove the gas, and light the magnesium for a moment to see that all is right; fix a plate in the dark slide, and put the slide into the Camera; cover the lens, draw the shutter up, and expose. No rules can be laid down for the time to be given, as the conditions vary so considerably; but with plates ten times as sensitive as wet collodion, and a one-inch objective, a minute should suffice. The majority of amateurs expose dry plates too long, whereby they get misty pictures with no contrast. The Pyro-Glycerine developer is the best to use, and the following is Mr. Fry's formula for it; the

directions for developing are also his, with some alterations:—

(A.)	Pyrogallic Acid ...	... ...	1 oz.
	Glycerine ...	... ...	1 oz.
	Methylated Spirit	... ...	6 oz.

Mix the Glycerine and Spirit, and pour into the Pyrogallic bottle.

(B.)	Bromide Potass.	... ...	200 grains.
	Liquor Amm.	... ...	1 oz.
	Glycerine	... ...	1 oz.
	Water ...	... ...	6 oz. Mix.

(C.) 1 oz. of A to 15 oz. of water.
(D.) 1 oz. of B to 15 oz. of water.

Into a measure pour, for a quarter-plate, 1 oz. of C solution and 1 oz. of D; when the plate, which is now in water in an ebonite dish with a cardboard cover, has soaked for a minute, pour the water quickly off, and pour on the developer. If the exposure has been correctly timed, the image will begin to appear in about 20 seconds, and in about 3 minutes will have attained sufficient strength: the negative may then be slightly rinsed in water, and put at once into the Alum-bath (Alum 1 oz., Water 20 oz.), where it should stay for ten minutes, but not longer. Then wash very thoroughly and immerse in a Hypo. bath (Hyposulphite of Soda 1 oz., Water 5 oz.); this should not be used too often or it becomes discoloured, and stains the clear parts of the negative. Wash well again after fixing. It is necessary to soak the negative in water for two hours to get rid of all traces of Hyposulphite; then allow the plates to dry spontaneously, and varnish in the usual manner.

The directions given with each parcel of dry plates regarding the precautions necessary to prevent injury to the plates by light, should be strictly attended to.

If the amateur is using a power that is not corrected for photography, he must determine the actinic focus in the following manner:—Focus the object as distinctly as possible, and expose a plate; the negative thus taken will probably be very indistinct. Turn the milled head of the fine adjustment so as to bring the objective away from the slide, until the picture on the screen coincides with the negative: this will be found to be the right actinic focus. I am told that a piece of ground glass, placed between the condenser and the microscope, gives an even, opaque background to the picture, though, of course, there is great loss of light; but I have not tried this, and am, therefore, not certain how far it will answer. The amateur should work only with low powers until he has had considerable practice; for

those higher than the ½ inch, an achromatic condenser will be required.

From the foregoing, it will be seen that Photo-Micrography and Photo-Enlarging are as nearly as possible identical operations; in fact, I have obtained in this way several fairly good pictures of the larger microscopic objects, mounted by Enock, such as Larva of Vapourer Moth, *Orgyia antiqua*—Fan-Tail Fly, *Dolichopus nobilitatus*—Green Saw-Fly, *Tenthredo Viridis*, etc. If it is intended to make transparencies for the Lantern from the Micro-Negatives obtained, I recommend the carbon process: it is not difficult, and the results are very superior. The tissue is supplied by the Autotype Company.

Dr. Koch, of Berlin, has sent some Photo-Micrographs to Professor Lister, of King's College, which far surpass anything that has hitherto been done: they are pictures of some of the minutest living organisms, and were executed, I believe, to illustrate the germ theory of disease. They were exhibited at the International Medical Congress recently held in London; and I append a few details of his mode of working, copied from "The Photographic News." He uses an immersion lens, by Siebert and Kraft, of Wetzlar, and for illumination employs sunlight reflected by means of a heliostat. A wide-angled condenser concentrates the light, which is passed through an ammoniacal solution of copper, rendered as monochromatic as possible, and then diffused and softened by allowing it to pass through ground glass. He works with wet collodion, and finds that an exposure of two minutes suffices in the case of an enlargement of seven hundred diameters.

I have endeavoured to make the foregoing article as plain and simple as possible, remembering that my own early attempts at Photo-Micrography were attended with many difficulties and failures; for all the articles which I read bearing upon the subject were so utterly unpractical, or so highly scientific, that a beginner could glean from them but little information of any real value.

Stylaria Paludosa.

By A. Hammond, F.L.S.

Plate 8.

THE subject of this notice was brought to me a few weeks ago by my friend Mr. Baily, who informed me that he had witnessed the act of fission in a similar specimen a day or two previously. The alleged reproduction of the Naid worms by a process of fission, as I stated in a note on my paper on Tubifex, received the most strenuous denial from Dr. Williams, the author of the report on the British Annelida.* After quoting a statement by Professor Owen, to the effect that in this very worm a proboscis shoots out from the posterior portion, which is then detached from the parent worm, he says:—"On the authority of hundreds of observations laboriously repeated at every season of the year, the author of this report can declare with deliberate firmness, that there is not one word of truth in the above statement. It is because accounts so fabulous have been rendered respectable by the fact that Professor Owen has thrown over them the ægis of his great authority, that they demand a contradiction, which may displease by the strength of the language in which it is given." I had previously been led to doubt the correctness of Dr. Williams' positive conclusion with respect to Tubifex, and my doubt was confirmed upon seeing the elaborate and exhaustive memoir by Bonnet of his experiments upon these animals,—experiments which, it seemed to me, were not to be lightly set aside. It was, therefore, with peculiar pleasure that I heard from Mr. Baily his account of the fission of Stylaria as witnessed by him, and received from him a specimen which I determined to watch. On the 24th February, the worm presented the appearance shown in Plate 8, Fig. 1, where it will be observed that it possesses a long, fleshy proboscis,—whereby it is distinguished from Nais,—and a pair of eye-spots. A pharynx, or dilatation of the alimentary canal, immediately succeeds the mouth, and the first three or four segments, including the head, are devoid of bristles, a special feature of the Naid tribe. We note again that the long filiform setæ which adorn the body are interrupted at about the posterior third of its length, where a constriction occurs. The interruption, however, is more apparent than real, for if examined under a $\frac{1}{4}$-in. objective, the integument of this portion is seen to bear a series of minute

* British Association Report for 1851, p. 247.

setæ, both hooked and filiform, very closely set together, and differing from the others only in their minute size; the filiform ones, however, being confined to the portion preceding the constriction, which Mr. Baily told me was the point of division of the worm. The intestine, it should be noted, is continued past the constriction; though the glandular covering, which elsewhere, as in Tubifex, gives it its colour, is here deficient—a deficiency which is again apparent in the anterior segments. On the 27th, I found the small setæ, which had previously been difficult to make out, longer and much more clearly marked. The intestine was continuous as before, but, *mirabile dictu*, a new proboscis was seen immediately below the constriction, waving about as if to feel the surrounding objects, exactly as did its prototype (see Fig. 2). Also, a pair of new eye-spots were distinctly visible, and something very much like a new pharynx adjoining the intestine; but of this last observation I am not quite sure. On the 28th my worm had divided, and become two perfect worms: I did not, indeed, as Mr. Baily had done, see the separation, but the fact was placed beyond all dispute. The process evidently consists of the interposition of a number of new segments, both above and below the point of separation; these being at first, as might be expected, much crowded together, as indicated by the minute size and close setting of the new setæ, which gradually grow and separate from one another as differentiation proceeds. Inasmuch as no new filiform setæ are produced below the separation, this is in exact conformity with the type of the original, which requires the absence of these setæ from the anterior portion of the new worm produced by the fission. By the absence, again, of the glandular covering of the intestine in the new segments posterior to the constriction, provision is made for the reproduction of this feature also in the new being. The intestine itself appears to remain entire till the moment of separation; for, on comparing the new worm with the original, it is at once seen that the mouth of the former is as yet imperfect, requiring time for its complete development (see Plate 8, Figs. 3 and 4).

Dr. Carpenter* gives the following details concerning the fission of Nais:—"After the number of segments of the body has been greatly multiplied by gemmation, a separation of those of the posterior portion begins to take place; a constriction forms itself about the beginning of the posterior third of the body, in front of which the alimentary canal undergoes a dilatation, while on the segment behind it a proboscis and eyes are developed, so as to form the head of the young animal, which is to be budded off; and in due time, by the narrowing of the constriction, a

* Principles of Physiology, 3rd ed., p. 934, par. 714a.

complete separation is effected, and the young animal thenceforth leads an independent life. Not unfrequently, however, before its detachment a new set of segments is developed in front of it, which in like manner are provided with a head, and separated from the main body by a partial constriction; and the same process may be repeated a second, and even a third, time, so that we may have in this animal the extraordinary phenomenon of four worms, which are afterwards to exist as separate individuals, united end to end, receiving nourishment by one mouth and possessing one anal orifice." Strange to say, this passage is quoted by Dr. Williams as "an illustration of the extraordinary degree to which the groundless fancies of the older observers have taken captive the imagination of the moderns." It is a pity that a work replete with interesting and valuable information should be marred by such a positiveness of assertion, which, as Dr. Johnson truly says, "is unlike that with which a prudent man dealeth with knowledge." I would remark, in conclusion, that two or three segments of this worm are provided with pulsating vessels, viz.—those immediately following the head—a feature which is denied them according to the synoptical table of Claparède, * but distinctly recognized by O. Schmidt. † I also observe that the blood-corpuscles are lenticular, presenting their edges as they roll over; and the small setæ are simply hooked, as shown in Figs. 5 and 6.

On the Larva of Tanypus Maculatus.

By A. Hammond, F.L.S.

Plate 8.

THERE appears to be some confusion about this insect. Walker ‡, curiously enough, describes the larvæ of two species of flies—viz., of *Tanypus maculatus* and *Tanypus monilis.* His description of the latter is exactly that of the subject of this paper, that of the former being very different, as *inter alia* he speaks of its having ten legs. Having thus led his readers to

* Memoires de la Soc. de Phys. de Geneve, Tom. 16, p. 221.

† Ann. des Sci. Nat., 3rd Ser., 7 and 8, 1847, p. 183.

‡ Insecta Britannica, vol. 3, pp. 197—8.

suppose that there are two distinct flies with two distinct larvæ, we find in his specific description of the perfect insects, that *Tanypus monilis* is synonymous with De Geer's *Tanypus maculatus*, * and also with that of Latreille, † the larvæ of which in either case, as evidenced especially by De Geer's figure, are identical with one another and with mine. Whatever may be the explanation of this paradox, the Tipulid larva I purpose here to deal with was known to De Geer as that of *Tanypus maculatus*, and was described by Walker under the name of *T. monilis*. It is a type of a number of somewhat similar larvæ, none of which, so far as I can find, have ever been described, and whose habits and transformations are, I believe, entirely unknown. Its minute size and the transparency of its tissues render it especially adapted for microscopic study, and as a starting point for the study of other allied forms.

The larva (Pl. 8, Fig. 7) is composed of 13 segments, including the head, which is distinguished by the denser and yellower character of the integument, upon which are situated a pair of conspicuous eye-spots. The front of the head (Fig. 8) exhibits a pair of setaceous organs, which I must be content to describe as antennæ, though I am doubtful as to their function. They appear to occupy the place which undoubted antennæ do in other species, but they have two peculiarities which seem to remove them functionally from those organs :—firstly, they are retractile, having a muscle at their base by which they are occasionally withdrawn a considerable way into the head, from which they can be again protruded by some unknown agency; and secondly, they seem to be furnished at the base with a saccular organ, reminding one of the poison-gland of spiders. Both of these features lead me to regard them as lethal weapons, whatever may be their homological relations. In the same situation, also, we find a pair of strong mandibles (Figs. 8 and 20), and between these appear a pair of pointed maxillæ, the inner basal angle of which is furnished with an appendage consisting of a group of pyriform cells (Fig. 17), a feature so strange that I was doubtful at first whether they were not minute *Vorticellæ*, till prolonged observation convinced me to the contrary. I have never seen anything similar in any other insect. Below the maxillæ is seen the labium, the front edge of which is raised into a number of little rounded projections.

Perhaps one of the most striking features of this and similar larvæ are the singular grappling appendages, which supply the place of feet (Figs. 7, 10, and 12). Two pairs of these are found,

* De Geer, Mem., Tom. vi., Plate 24, Figs. 15—19.

† Hist. Nat. des Cruse et Insect, Tom. iv., p. 248.

—one beneath the prothoracic ring, and the other at the termination of the body; the former corresponding to the front pair of thoracic limbs, and the latter to the anal pro-legs of caterpillars. Both pairs are built on the same plan, and consist of coronets of recurved hooklets surmounting retractile fleshy footstalks. The anterior pair can, perhaps, be scarcely described as a pair, since the two branches coalesce into one common stem arising from the centre of the under-surface of the segment. In other species, however, the insertions are distinct. We may see occasionally the two coronets withdrawn into their respective branches; then these are withdrawn into the common stem, and finally the whole disappears into the interior of the body. These organs are used by the larvæ to grope their way among the flocculent sediment in which they are found, and confer, as might be expected, but little locomotive power upon their possessors.

The whole course of the alimentary canal can be easily traced. The anterior portion constituting the pharynx receives in its passage through the head the insertion of a mass of powerful muscles, which have their origin in the integument, and which serve to dilate its cavity when occasion requires for the passage of food. These muscles stand out in brilliant colours under the action of polarized light.

Immediately behind the head we find two large and delicate sacs, lined with epithelial cells, and each terminating anteriorly in a small duct which joins with its fellow of the opposite side. The common duct thus formed, I have not been able to trace, but analogy leaves little doubt that it enters the pharynx immediately behind the mouth. The sacs are the salivary glands, and the duct is the salivary duct.

After passing the salivary glands, the œsophagus suddenly widens into a large crop, the counterpart of what is known as the sucking-stomach of the fly. In this may frequently be discerned two or three small Crustacea, such as *Chydorus sphæricus*, just swallowed, lively enough as yet, and making vigorous but futile efforts against the walls of their living prison. The crop is succeeded by the proventriculus, an organ that corresponds to the gizzard of the cricket, so much admired as a microscopic object for its rows of horny teeth.* No such teeth, however, exist in the proventriculus of the Diptera, but the organ is surrounded by a number of cæca or blind-appendages, as shown in the drawing.

The proventriculus is followed by the ventriculus or true digestive cavity. Here again we find *Chydorus*, but its struggles are now at an end, and under the action of the gastric juice it is

* I observe that Newport says there is no gizzard in the Diptera. The organ I have above described evidently occupies its place, however different in appearance and function.

slowly dissolving away, and becoming undistinguishable from the mass of food-matter that fills the stomach. At the pyloric end of the stomach occurs the insertion of the biliary tubes, four in number,—two passing forward and two backward,—and surrounding the stomach and intestine. From this point the intestine is continued as a straight tube to the anus.

In the thoracic segments succeeding the head we may discern (if the larva be sufficiently grown), in addition to the salivary glands, certain cellular structures in pairs,—four on each side, as shown in Fig. 18. These are the imaginal discs from which in due time the legs and wings of the future fly will be developed.

The nervous system is best seen in very young specimens. It consists of a chain of ganglia united by double nervous cords, as shown in Fig. 11. This, however, is wanting in the cephalic ganglia, which I have not been able to make out.

I have omitted to mention that near the extremity of the body there occur two pencils of fine hairs, and that the anus is surrounded with four fleshy appendages, the use of which I do not know. They are, however, very much developed in the larva of *Chironomus plumosus*, known as the "blood-worm," where, I think, they are concerned in the formation of its tube.

In the month of August, 1880, I found in a pond in the Crystal Palace grounds, some circular gelatinous masses containing eggs (as shown in Fig. 9), adherent to floating sticks, leaves, etc. I soon found that some of the egg-masses were in course of development, and were producing young larvæ, which I recognised as that of *Tanypus*. Whilst still in the egg, the position of the eyes and the alimentary canal, as well as the segmentation of the body, could be well discerned, and they are shown in Figs. 13, 14, and 15. The young larva resembles the adult, but is slightly thicker in proportion to its length: the alternate protrusion and withdrawal of the antennæ was well marked, as were also the pulsations of the dorsal vessel.

In conclusion, I should like to refer the reader to a very interesting account in "The Intellectual Observer" for February, 1864, by the Hon. Mrs. Ward, entitled "A Windfall for the Microscope," and describing certain larvæ very similar, if not identical, with mine; the eggs of which, together with those of a species of *Phryganea*, were deposited abundantly on the sails, deck, and rigging of a yacht lying at anchor in Lough Ree, co. Westmeath.

EXPLANATION OF PLATE VIII.

Fig. 1.—Stylaria paludosa, showing incipient division of the body at ×

,, 2.—Portion of the body, showing the constriction more advanced; the new setæ, and the formation of new proboscis and eye.

,, 3.—Head of new worm just detached, showing imperfect mouth.

,, 4.—Head of original worm, showing mouth fully formed.

,, 5.—Blood-corpuscles.

,, 6.—Hooked seta.

,, 7.—Larva of Tanypus maculatus:—*sg*, salivary glands; *c*, crop; *p*, proventriculus; *v*, ventriculus, or stomach; *bt*, biliary tubes; *i*, intestine.

,, 8.—Head of larva:—*aa*, antennæ; *l*, labium; *m*, muscles; *t*, trachea.

,, 9.—Eggs of Tanypus maculatus.

,, 10.—Anal foot.

,, 11.—Nervous chain from young larva.

,, 12.—Hooklet of anal foot.

,, 13.—Egg, front view.

,, 14.—Ditto, side view.

,, 15.—Ditto, more advanced, showing alimentary canal (*a*), and segmentation of body.

,, 16.—Young larva, a day old.

,, 17.—Pyriform cells attached to maxilla.

,, 18.—Thoracic segments of worm, shewing—*sg*, the salivary glands, and *dd*, the imaginal discs.

,, 19.—Root of antennæ, with muscle and sac attached.

,, 20.—Mouth-organs, etc.:—*aa*, antennæ; *mm*, mandibles; *m′m′*, maxillæ.

A New Method of Preparing Minute Microscopic Organisms.

IN a recent German periodical, the "*Zoolog. Anzeiger*," vol. 4, Professor G. Entz describes the method used by him in mounting minute organisms for the microscope, such as Protozoa, Rotifera, Infusoria, etc. He first enumerates some of the plans which have been previously tried, referring especially to the mounts exhibited by Duncker in 1877, which showed numerous fine details in a most wonderful manner, but unhappily were not permanent. He then goes on to say that, according to his experience, there are various means well adapted for fixing the smallest and most delicate organisms—such, *e.g.*, as pyroligneous acid, picric acid, chromate of potash in glycerine, etc.—but that a preparation strongly recommended by Dr. Paul Mayer for the lower animals—viz., picro-sulphuric acid—should certainly have the preference over all others. This is prepared, according to Kleinenberg's formula, as follows:—

100 parts, cold saturated solution of picric acid in water;
2 parts, strong sulphuric acid.

Mix well together, and filter; and when diluted with three times its bulk of water, it is ready for use. One great advantage of this medium is that it supplants the water and other fluids in the animal's body; and after having done its work, allows itself to be entirely removed and replaced by alcohol. With *large* objects, a sufficient quantity of it must be used, and generally it is needful to open the body well with a pair of scissors, so that the liquid may penetrate more thoroughly, as it passes with difficulty through thick *chitine*. It must be used before or immediately after death,—time not being allowed for the blood or animal-juices to coagulate and fasten the organs together; neither, of course, should it be employed for animals containing carbonate of lime, where that is desired to be preserved.

But its principal use in the hands of Professor Entz is for the preservation of minute organisms, as already mentioned. These it kills instantaneously, without injuring their structure, and fixing the smallest details as in life—even flagella and cilia, the suctorial disks of the Acinetæ, or the pedicels of rapidly-jerking Vorticellæ. Rotifers, such as *Carchesium* and *Epistylis*, may often be fixed in the act of lively rotation, though they generally die with the peristomes moderately withdrawn. Infusoria may be caught in the act of fission or conjugation; and nucleated

elements come out also prominently. *Spongillæ*, *Hydræ*, small Nematodes, delicate Insect-larvæ, the ciliated gills of Mussels, etc., may all be excellently fixed and preserved. But to make these preparations durable, it is absolutely needful that the fixing fluid be removed when it has completed its work, as it might otherwise injure or decompose the organisms by longer action.

Professor Entz then describes his method of procedure in the following terms, which we borrow from "The Journal of the Royal Microscopical Society," vol. II., p. 121:—"I place the Protozoa or other microscopical organisms, together with the Algæ, sediment, or other objects to which they are attached, with some water in a watch-glass, and then drop in a few drops of the fixing fluid, which I allow to act only *one to two minutes*. I then pour off the fluid carefully, or simply lift the preparation out with a pencil, in order to transfer it at once into a larger quantity of alcohol, which must not be too strong. Half-an-hour is usually enough to withdraw the fixing fluid and replace it by the alcohol, in which it may remain for a longer time without damage. For removing the chlorophyll colouring-matter of many Infusoria, and also of the Algæ in the preparation, a longer stay in alcohol is of course necessary, replacing this by clear alcohol when it has become coloured.

"Microscopical organisms thus treated may then be mounted at once in equal parts of glycerine and distilled water. But colouring must not be neglected. Carmine certainly is to be preferred, because it is not bleached in glycerine, and does not colour everything with one tint like the aniline dyes, but principally the nuclear elements. Preparations transferred from alcohol to carmine are mostly coloured sufficiently in ten to twenty minutes; only loricated forms, such as *Euglena*. *Spirogyra*, the *Peridineæ*, etc., require several hours to make their nuclei sufficiently prominent. To remove superfluous dye, the preparations must, of course, be put into distilled water before being transferred to the glycerine: they should remain in it until the yellow picric acid is drawn out, and only a nice rose-colour remains.

"Beautiful and instructive preparations may thus be obtained, which when carefully mounted show no further change. I have a fairly considerable collection of different Protozoa, which have not altered in the least for six or seven months, and are adapted both for demonstration and for detailed study."

An Hour at the Microscope,
With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

PLATE 9.

THERE is no more delightful way of spending an evening, that I know of, than to get together a few friends when a Box of Slides arrives, with books, etc., at hand for reference in case of need, and then, with the microscope on the table, to observe, compare, and discuss, whatever the box contains; trying to clear up any doubtful points, and to gain or to impart fresh knowledge, through the medium of the Note-Books. I strongly recommend the plan to members who may live sufficiently near each other to make it practicable.

With regard to the question of "bought" Slides, there can be no objection to members *occasionally* sending round a good, instructive, professional mount; but the fact of its being such should be distinctly stated. Slides mounted by real workers, with a definite object, are infinitely better and more interesting than the gay things got up by professional mounters, which sometimes resemble certain well-known razors, "made to sell." Would that all our members might continually remember that our future as a Society depends greatly upon the character and quality of the work that we do! We have great opportunities for self-improvement, if they are honestly embraced and utilized; but if these are let slip, and members are content to use the microscope merely as a plaything, to while away a leisure hour, or for the exhibition of pretty things, then we shall probably soon fall to pieces, as we shall deserve to do.

Diatoms.—Try to draw these, if you can, with the camera, giving all the reticulations, etc., just as they occur,—and then feel for the poor artist, who has to give weary years to drawing and engraving them; the latter process, with some of the more elaborate ones, taking a fortnight for a single disc. And wonder not that he heaves a sigh of relief as he removes the last slide from the field of his microscope, and rejoices when engagements permit of his turning to other branches of microscopical drawing and research than Diatoms.

Sphagnum, portion of Stem.—There is, in its way, no object more beautiful than that furnished by the leaves of the Bog-Mosses. It is preferable to mount them at once in Glycerine, as

obtained, and then the two forms of cells, parenchymatous and spiral, are well seen, as also the openings of the latter. It is a curious sight to see Infusoria passing in and out of these holes, and making themselves quite at home in the restricted domain of a cell of Bog-Moss. Professor Huxley, in an article in the British and Foreign Medical Review, has written to the effect that by carefully dissecting the growing point in Sphagnum it would be found that a stage would at last be reached where no difference could be traced between the sinuous, narrowly-elongate cells containing chlorophyll, and the large spiral-bearing air-cells which they surround; though these are so very different in the mature condition. An early enunciation in fact of the law of differentiation, which has helped so materially in the recent march of scientific research.

Sphæraphides from Echinus Vesnagii.—John Quekett preferred maceration for the purpose of obtaining Sphæraphides, and I can certify that it is the safest way. Liquor Potassæ may be used, but it is powerful stuff; I am afraid of it. "Pulvis Rhei" of the druggists will furnish very fine Sphæraphides; and sections made of the root will show them *in situ* capitally, along with the rich red-brown cells bearing the fragrant resin which gives this drug its officinal value. Quekett ascertained, and stated, the curious fact that the number of Sphæraphides in Rhubarb root may be taken as an index of its quality,—the best Turkey being very rich in them, but the dressed-up English, sold by sham Turks, containing comparatively few. The same genial climate which nourishes the cathartic products, is alike favourable to the growth of these crystalline accompaniments, both in abundance and in size. There is a good article under the head of "Raphides," in the Micrographic Dictionary, which should be consulted by all would-be workers at the subject. If *practicable*, Professor Gulliver's various papers should also be read: they are scattered through various periodicals, some difficult of access, and many, alas, buried and all but lost to science in the proceedings of a local Microscopical Society!

Trichina Spiralis.—Could anything more conclusively show the value of the microscope, than that it enables us to find out the cause, otherwise mysterious and inscrutable, of one of the most dangerous and deadly diseases? We take a bit of infected muscle, some ¼-inch square, and a mere film in thickness, and find in it perhaps 70 of these death-inflicting creatures! The literature of Trichina and Trichinosis is now a copious one; the best way to get at it will be to consult a medical friend; or we may read a most complete account of it in an old volume of the Transactions of the Pathological Society of London, by Rainey

and Bristowe. A scourge to man, due to neglect of sanitary conditions! In my neighbourhood is a *Pig Club*, the cottagers belonging to which, by paying small subscriptions, mutually insure against total loss when one of their pigs die. They have their own butcher, specially retained to exercise his calling at any hour of the day or night, when "piggie" is seen to be "*in extremis*." I have known instances where animals have died before he could reach them, and where, judging from all that I can now remember concerning the symptoms, there could be little reasonable doubt that Trichinosis was the cause of death. And what became of the animals so suffering, and killed "in time?" Too often they were sent to market, or otherwise disposed of, and the mischief they may have been the cause of, or that may be done in this way, no human being can tell.

Proboscis of Tortoise Tick (Plate 9).—This object is one most difficult to procure, and the best way is for the owner to cut it out of its moorings himself. The *Proboscis* is the *Labium* or upper lip, modified for the requirements of the creature, and it differs in appearance very considerably in the different species of Ticks. The drawing is that of the mouth of Tick from common Tortoise. I have consulted also a slide of Ixodes (purchased), said to have been taken from a Magpie. Both are balsam-mounted, both crushed down; but so far as I can read them in their present state, all agree in saying this—that the mucrones (tooth-like points) are on the *under* surface of the labium. This is buried in the host by an operation which may be described as follows:—Did you ever see a Mole working its way into the earth? It is a highly curious and instructive operation. The hands—a combination of digging-fork, shovel, and scavenger's brush in one—*cleave* the earth asunder; whilst the nose, armed with its special bone, and densely-ossified nasal cartilages, is pushed forwards with a motion alternating from side to side, and the creature, under favourable circumstances, disappears almost in a twinkling. I had recently a capital opportunity of watching one in an enfeebled condition under a large bell-glass, so that I was able to observe the whole process thoroughly.

Well, the Ticks having found their victim, attach themselves thereto by the help of suckers, almost circular in outline, with one of which each of the eight limbs terminates. Then the mandibles, or maxillæ, or both combined (figured on either side the labium in my sketch, see Pl. 9, m.m.), *push aside, as it were, the flesh*, with instruments like a veterinary surgeon's "fleam," and a three-prong fork, having the "tines" bent sideways on the handle. The saw (labium) is then introduced, and by a little gentle motion backwards and forwards of the body on its fixed supports, it soon

completes the task. Now this instrument remains buried almost up to the hilt, and *cannot be withdrawn by force;* the head is just torn off in the attempt; but if you want to remove them, *tickle them*, i.e., brush them over with oil, and being stifled, they will seek to escape, and you may then secure them. For about the front half of the labium, on its upper surface, is an open channel: at the hinder half, attached to this channel on either side, is an elastic membrane (see diagram Pl. 9, Fig 3b). Along the middle runs a white line, the indication of a ridge, which prevents the membrane falling in, and so destroying the vacuum. So far as I can judge, I think that the arrangement at the base may be very probably adapted for sucking; but it would require the dissection of fresh specimens to feel confident on such a point.

I once purchased a Tortoise on the flags at the Exchange, which to my delight had some 30 specimens of its Tick upon it; and several specimens have been also brought me in the living state, of the species which occurs on the Weasel. I wish members would collect all the Ticks they can—there is one not uncommon on the Dog; one is found on the Sheep; one occurs on the Deer; and one in the nest of the Bank-Swallow. No doubt there is a vast number of species, on which scarcely anything has as yet been published. Some species occur in America, which are known there by the name of "*Piques*," whose attacks are very distressing, and sometimes dangerous, both to men and cattle. Members having relatives or correspondents there, who could procure some of these, would be able to render right loyal service. The "insects" which are so troublesome at times to canaries and other singing birds, should be sought for; to put them into glycerine at once, is the best way to preserve them. The Pigeon Tick—*Argas reflexus*, is also worth notice. I have little doubt it is the "large Ixodes," which Denny mentions having found on the Pigeon (Mon. Anop. Brit., p. 173), and any of our members having access to Dove-Cotes, might be able, with a little exertion, to secure them.

Egg of Louse of Vieillot's Pheasant.—*Goniodes Colchici* is the name of the Louse of the Common Pheasant. I cannot just now say whether the Louse of Vieillot's Pheasant be the same species, nor do I know the eggs of the parasite of the Common Pheasant. In mounting such objects one may injure their value materially, by sticking a lot together for the sake of effect, instead of being content to obtain this truthfully, by attaching portions of feathers to the glass slip—each independently. I never knew eggs to occur in groups, or in such large clusters as are sometimes shewn. I have seen a singular chitinous thread attached to the lid of one of these eggs. Is it merely casual, or does it furnish a mark of specific distinction?

On principle, I very much dislike to see objects mounted with an irremoveable *black back-ground.* When it is desirable to view objects as opaque, there are so many other ways of doing this; *e.g.*—the diaphragm, or the dark-well of the opticians, or a piece of dead-black paper, cloth, or velvet, placed behind the slide; it can then still be viewed as a transparent object also. Otherwise it is the mounter saying to the observer—"You shall see my slide as *I* will, and in no other way."

TUFFEN WEST.

Sphæraphides of Cactus were obtained from Mr. Peacock, of Hammersmith, who imported a very fine specimen, but it fell to pieces in travelling; he very generously distributed the pieces for the benefit of Microscopists generally.

These Sphæraphides required no maceration; a little grating together, or merely rubbing with the finger, is sufficient to reduce the tissue to powder, and the Sphæraphides are easily separated by allowing them to roll down a sheet of writing paper. The little balls readily separate from the remaining *debris*, and the process may be repeated once or twice if necessary. They show much the best with a little light from below, or with spot-lens.

H. E. FREEMAN.

Turkey Rhubarb.—Just one passing observation as to Mr. West's suggestion that we should look for Sphæraphides in *Rhei Pulv.* I have read that real Turkey Rhubarb is scarcely ever seen now, and that the best houses have ceased to quote a price for it in their lists. Mr. West speaks of the "dressed-up English" Rhubarb, and this reminds me that the dressing is, or used to be, one of the indications of quality. If my memory serves me, the Turkey (real) or Russian used to be always clean-cut with a knife, and therefore the edges, or "arrises," were left sharp, or at least angular; but the East Indian variety, which is much inferior in quality, and much lower in price, is, or was, always finished with a file, and consequently presented no "arrises," although it is thus made to look neater to the eye of the purchaser. Sphæraphides are not plentiful in the E. I. Rhubarb.

W. LANE SEAR.

Dark-ground Illumination.—I find that many objects show better, not with a black, but with a white or porcelain back-ground, and it is useful to have the following slips of glass, of the same size as slides, both for opaque and transparent objects:—

Pale Blue, for destroying the yellow glare of the lamp. For transmitted light.

Ground Glass, for bringing out with good definition Foraminifera, etc. For transmitted light.

Opal or Porcelain, or even *China*, for viewing dark objects as opaque, such as Seeds, etc. For reflected light.

Glass Slips, *dull-varnished on one side*, useful for most opaque objects. For reflected light.

These should be slipped under the slide on the stage of the microscope, and may be procured at a very trifling cost.

E. LOVETT.

Proboscis of Tortoise Tick.—I cannot make out any terminal opening. Mr. West's account of the channel for suction may be right, but it cannot be made out by examination of a mounted specimen; and certainly if the membrane described were "elastic," it would prevent the passage of juices, by being drawn into the channels. This remark of Mr. West's puzzles me. What proof is there of its elasticity? and what is the supposed need of elasticity in relation to it? The central support could not prevent the membrane falling into the two channels thus formed. I suppose we must conclude that the elasticity of the membrane and the power of suction are invariably well balanced; but is it elastic? and why? D. MOORE.

Eggs of Louse of Vieillot's Pheasant differ from those of Reeve's Pheasant in having much coarser reticulations; the general shape is the same; the thread attached to the lid is present, and when absent it is probably accidentally removed. It is a very common appendage to louse-eggs, and it occurs in 6 or 7 out of 8 different species that I have. Are these egg-shells chitinous?

D. MOORE.

Mr. West's reply to the foregoing notes:—

Dr. Moore's remark on the thread attached to the lid of the Louse's Egg is highly interesting. This is a subject well worthy of study. I believe there is no publication on them as a class yet, and they would form excellent material for our "Proceedings," stimulating intelligent inquiry into the subject as well.

If these egg-shells in question be not chitinous, of what material are they composed? Simply animal membrane? Some appear from their porcellaneous lustre and brittleness, as if they might be impregnated with earthy salts,—Carbonate and Phosphate of Lime probably.

The Larvæ of Bird-Lice push off the cover of the beautiful "urns" in which the first stage of their existence is passed, when

ready to make their exit. Previous to leaving, they cast their first skin, which may frequently be seen left behind.

More on Tick's mouths, when materials have been obtained sufficient to render a discussion of use—mine was merely a suggestion thrown out to excite remarks from other members. I do not now, after examination of the mouth in several other Ticks, in Human Lice, and in some Pycnogons, think it quite correct, yet neither does Dr. Moore's theory of a "closely fitting piston," appear to accord better with what I find. T. WEST.

EXPLANATION OF PLATE IX.

Fig. 1.—Proboscis of Tortoise-Tick, × 100.—*m*, *m*, Mandibles; *l*, toothed Labium or Rostrum.

Fig. 3.—Ideal transverse sections of the Labium, taken at the points *a* and *b*, shown on Fig. 2.

Selected Notes from the Society's Note-Books.

INORGANIC.

Clifton Oolite.—The small egg-shaped nodules found in this rock seem to be formed by successive layers deposited round minute fragments of various foreign bodies which serve as nuclei. Among these may be noticed portions of Echinus spines,—bits of Coral, such as *Favosites*, *Heliolites*, and others,—fragments of Encrinoids,—minute shells and Foraminifera, etc. They all seem to be of animal, not of vegetable origin. The same organisms which are found in the Oolite are found also in the Carboniferous Limestone; and at Clifton may be seen strata of Oolite, some 20 feet thick, with layers of the Limestone lying both above and below them. Here and there one finds, imbedded in the mass of Oolite, pieces of Encrinoids of considerable size,—as large sometimes as a small bullet. The nodules possess a granular, rather than a crystalline structure, and often exhibit concentric rings.

The formation of this rock one may imagine to have proceeded somewhat as follows:—On a shallow, sandy shore, partly strewn with broken bits of shells, corals, encrinoids, etc., there has been

heavy rain, churning up the fine particles into mud. This again has been dried and cracked by the sun, and the broken and separated fragments have been rolled along hither and thither by the wind. Many of them are driven into the water, where they get massed together, and become stationary; while as time goes on, other deposits are formed over and around them, and so the Oolite is found sometimes imbedded in the limestone, sometimes interstratified with it.

T. INMAN.

Nummulites; from *nummus*, money,—owing to their coin-like shape. There are few forms which play a more important part than these do in the configuration of some portions of the earth's surface. Originally the shelly, calcareous envelopes of Protozoan Rhizopods, they have been welded together by geologic action, and now constitute very massive and important rocks. One huge stratum of Nummulitic Limestone, often attaining to a thickness of 1500 feet, extends through Southern Europe and the North of Africa; from Egypt it has been traced into Asia Minor, and thence through the Himalayas into India. It is from this that the Egyptian Pyramids were built; and the curious fossil forms attracted the attention of the ancients, being mentioned by Strabo and others. Many popular legends have been attached to them, one being that they were the petrified remains of the lentils used as food by the workmen who built the Pyramids. In Germany they were known as *Bauern-pfennige*, or peasant's penny, and as *Teufels-geld*, or devil's money,—both appellations being in common use. Later on they came under the notice of Naturalists:—Lancisi, an Italian physician, supposed them to be the Madreporiform plates of Echinites; Buckmann, that they were bivalve Mollusca, while other authorities classed them amongst the Cephalopoda; but in 1825 D'Orbigny ranged them in the class then first known as Foraminifera. In size they vary considerably,—from a mere particle to the bigness of a shilling; in a few cases even reaching as much as 4½ inches in diameter.

The grand era of the Nummulites was during the Eocene formation of early Tertiary times: existing forms are but a poor representative of the wonderful development reached by them at that period: they do still occur, however, though of humble dimensions, both in Arctic, Temperate, and Tropical Seas.

E. LOVETT.

BOTANICAL.

Puccinia graminis.—The genus *Puccinia* is characterised by its spores being divided into two compartments supported on a stalk; and however much their shape may vary in different species, the plan is the same. These *Pucciniæ* or "Brands" are very numerous, 52 species being described as British in Cooke's "Handbook." The most common of them is *P. graminis*, which may be found commonly on any pieces of straw left lying about; the difficulty will often be to find a straw free from it. On the straw its appearance is that of a brown, raised patch, of linear shape, which under the microscope is seen to be made up of tops of the spores densely packed together. On making a cross-section, we discover the stalked, uni-septate spores lying side by side.

Cooke tells us, however, that this form must probably be described as only one condition of a Fungus, which in other stages of its existence shows other and quite dissimilar forms. Thus, the straw *Puccinia* is preceded on growing wheat by the *Uredo* form called "Rust." This has a yellowish-brown appearance, and the spores are seen under the microscope to be simply globular, and without a stalk. It is known that these are two states of the same thing, and not two distinct fungi, because one finds sometimes on a leaf a patch showing both stages. This I have myself seen in several instances.

There is also another well-known Fungus, the *Æcidium* of the Berberry, which has long been popularly believed to be connected with the Wheat *Puccinia*. Cooke mentions a village near Yarmouth that was famous for mildewed corn, said to be produced by the Berberry bushes; and when they were cut down the Corn-Mildew disappeared. This was investigated by De Barry, who made experiments by applying Puccinia spores to healthy Berberry leaves, and succeeded in producing a growth of *Æcidium* on them, while other Berberry leaves which had not been so treated remained free from it. The subject is interesting and may be studied in Cooke's "Fungi," Vol. 16 of the International Scientific Series. It is curious to note how different the two Fungi are in appearance.

G. D. BROWN.

[The conclusions stated above, with respect to the connection between Corn-Mildew and the Æcidium of the Berberry, do not as yet command universal assent:—authorities differ on the subject, and it may therefore be regarded as being still under discussion.—*Editor*.]

Æcidium Ranunculacearum.—The cluster-cups of this Fungus grow in the leaf, and appear first as minute brownish spots; these expand until they burst through the epidermis, when they resemble little cups having a sort of fringe round the circumference, which is elevated above the leaf. These hollow cups, or peridia, are filled with an enormous number of globular spores, which become scattered and thus propagate the fungus. Cooke estimates their number at over 250,000 in each cup.

H. W. PEAL.

Ulva crispa is a congener of the well-known Sea-Lettuce, *U. latissima*, often grown in aquaria,—and of other marine species. *Ulva crispa*, however, is not marine, but terrestrial, growing on damp earth at the foot of walls; I have several times gathered it near London. It consists of a colourless, gelatinous membrane, having embedded in it numerous square green cells in close parallel rows: this arrangement gives rise to some curious optical appearances when seen with a low power.

H. F. PARSONS.

Aulacomnium androgynum is one of the Acrocarpous Mosses found plentifully in some districts, growing on rotten wood, etc., in plantations. The normal fruit of mosses is an urn-shaped capsule, but this species is very rarely found in fruit, and it is propagated by the male plant sending up a stem bearing a terminal globular mass of *gemmæ*, which in due time fall to the ground and produce new plants.

The Micro. Dictionary says that these *gemmæ* "are formed of only a few cells (3 or 4) at the time when they fall off, and illustrate well the independence of the individual cells forming the organs of these plants; where, under peculiar circumstances, a single cell of the tissue may be developed so as to lay the foundation of a new plant."

W. N. CHEESMAN.

Lophocolea bidentata belongs to the Foliaceous group of the *Hepaticæ*, or Scale-Mosses, and its fruit, when immature, is like a little black, shining, glass bead, on a white porcelain stalk. When ripe, the bead bursts suddenly, and the elaters, which lie loose inside the capsule and are very minute, spring out and scatter the spores. Specimens may often be found with the four valves open, and a great many elaters and spores lying on them.

In another species of Scale-Moss the elaters are *fixed* to the

sides of the capsule, and are quite as long as the valves are broad. A specimen mounted without pressure is most elegant under a 2-inch objective, since the elaters stand out from the valves.

H. M. J. UNDERHILL.

The chief differences between the *Hepaticæ* (Scale-Mosses and Liverworts) and the true Mosses are as follows:—In the former the capsule, as it grows upward, bursts through the perigonium, or membranous sheath which surrounds the pistillidium or female organ, so that the sheath remains like a calyx around the base of the fruit-stalk; in the true Mosses, the sheath splits around its base, and the upper part is carried upward as a cap or hood, (calyptra,) covering the capsule.

In the *Hepaticæ* the fruit-stalk is usually brittle and hyaline; in the true Mosses tough and bristle-like. In *Hepaticæ* the capsule bursts by splitting regularly into four valves; whereas in the Mosses (except in the genus *Andræa*, in which it splits into four valves, and in *Phascum*, in which it bursts irregularly) the capsule has a thickened mouth, closed, like that of an urn, with a conical lid, which at length falls off, frequently disclosing beneath it a beautiful series of teeth guarding the mouth of the capsule. In *Hepaticæ* there are found mingled with the spores bodies called elaters—spirally-coiled threads—which when the capsule bursts, elongate suddenly, and shoot out the spores like the spring of a toy-gun;—these are not found in Mosses. The leaves of *Hepaticæ* are very generally attached edgewise to the stem, and are frequently lobed and folded upon themselves. Stipules are met with on the under-surface of the stem in some species. Many, however, are frondose, having no distinction between stem and leaves.

H. F. PARSONS.

ZOOLOGICAL.

Hoplophora.—The family *Oribatidæ*, or Beetle-Mites, are related to the *Acaridæ*—of which family Cheese-Mites are a familiar example—in a way we should hardly expect. Beetle-Mites are, without exception, hard-shelled and very unlike the soft Acarids. But few species had been found in England until recently, and it is likely that more may yet be discovered if properly searched for. Within the last few weeks I have myself found two species, and a friend has found a third, which, if Mr.

Murray's " Handbook " on the Aptera is to be depended on, have not hitherto been found in England.

Hoplophora is one of the known English genera. One species of it lives in decaying Fir-wood; another on the roots of the Vine.

The following account, gathered from the above-named work, appears sufficiently interesting to be introduced here:—Claparède found *H. contractilis* in the burrows or borings in rotten fir-wood; but he sometimes found with it another larger, semi-transparent, soft, white mite, like a Cheese-Mite. One might naturally think that this was possibly the larva; but then it had *eight* legs, and therefore it was assumed that it must be in its mature state; moreover, by watching the eggs deposited by Hoplophora, Claparède soon ascertained that, as usual, the first stage was a six-footed, soft, white mite, bearing a close resemblance to the eight-footed soft, white, Acaroid form. What relation did the latter bear, then, to the Hoplophora with which it was associated? M. Claparède solved this by the following experiment:—He took twenty specimens of the soft, white, Acaroid Mite, and placed them on a morsel of decaying pine-wood, first making sure that there were no other mites present. After keeping the wood for three weeks in a moist flask, the Mites were scarcely to be seen. They had bored into the wood, and had to be dug out. On examination, he found only twelve specimens resembling Acarus against seven of Hoplophora. A transformation of seven had thus taken place, and one individual was missing. But the nature of the transformation was not yet clear. He repeated the experiments, and followed the traces of the transformation. He found that a perfectly colourless Hoplophora was *developed inside* the Acarus-like form. Those Acaroids which were becoming Hoplophoræ appeared very light to the eye. The perfect animal leaves the larval skin with its parts peculiarly tender. It then lies for a long time seemingly immoveable; but by degrees the coat thickens and becomes firm. From being colourless it turns rose colour, then reddish, and at last quite brown. An important point, however, remained doubtful. In all his experiments, several Acari, and these the largest specimens, did not change; how are these individuals to be looked upon? Perhaps as males. It is very striking that he did not find in Hoplophora any difference of sex, and that most specimens contained eggs. Nor could he, with any certainty, discover anything distinctive of the male sex. The important fact ascertained by M. Claparède is that the Hoplophora goes through an Acarus-like, soft stage, which proves its relationship to the real Acarids (Cheese-Mites, etc.)

From what I can make out, the mouths of *Hoplophora* and *Notaspis* are very similar. I have made a drawing of the mouth of the latter (Plate 10). It has two well-defined *maxillæ*—to give the organs a name,—although I very much doubt whether they be homologous with the maxillæ of insects. I have drawn the palpi standing out from the mouth instead of, as they naturally are, lying close to it, in order that the peculiarity of the termination of the head may be seen. This forms a kind of hood over the mouth, and the arrangement in Hoplophora is similar.

No Beetle-Mites have eyes, but it appears that for a long time the curious breathing-pores were mistaken for them.

H. M. J. UNDERHILL.

I have found Acarida on the Dung-Beetle, some of which have been brown and others white; perhaps these have been different stages of the same Acarus.

W. LOCOCK.

[Since the above Notes were written, various observers have been at work upon the *Oribatidæ*, and several new species have been discovered, while the transformations of some of these have been carefully watched:—much, however, remains yet to be done. One of the most careful and successful workers is Mr. A. D. Michael, F.L.S., who has read papers on the subject before the Royal Microscopical Society, illustrated with drawings of very curious examples of the family. These have been published in the "Journal" of that Society. His latest conclusions, as there stated, are to the effect that the *Oribatidæ* are not wholly viviparous, as some have thought, but chiefly "oviparous"; and that the young are brought to maturity in, at least, four different modes:—*First*, the egg is deposited in a slightly-advanced stage, as in insects; *Second*, egg deposited with the larva almost fully formed; *Third*, the female is occasionally viviparous, when only one egg is usually ripe at a time; *Fourth*, several eggs are matured at once, but not deposited. The mother dies; the contents of her body, all but the eggs, dry up; and her chitinous exterior skeleton forms a protection throughout the winter to the eggs. The occurrence of a *deutovum* stage in the egg is also recorded—*i.e.*, the egg has a hard shell which splits into two halves as the contents increase in volume, the lining membrane showing between, and gradually becoming the true exterior envelope of the egg.

The history of the death of the parent insect before the

escape of the ova is thought to be a very anomalous thing in nature,—the nearest approach to it being, probably, in the case of the *Coccus*, or Scale-insect, where the mother dies immediately after the deposition of the eggs, and forms a sort of roof over them with her dead body, which protects them during the cold of winter.

Mr. Michael has also ascertained that the soft, white, Acarus-stage passed through by *Hoplophora*, as described above, is not by any means confined to that species. He names other genera and species of the *Oribatidæ*, the larvæ of which live in Fungi or dead wood, which they perforate with long burrows in all directions until the substance is often thoroughly riddled by them,—the larva or nymph, as the case may be, being usually found at the end of the burrow farthest from the mouth, the last place to which it has worked. In all these instances, the larvæ or nymphs are soft, white creatures, entirely without the hard and dark defensive armour possessed by other members of the family which are more exposed to danger.—*Editor*.]

EXPLANATION OF PLATE X.

Fig. 1.—Beetle-Mite, *Notaspis bipilis*.
* Breathing-pores, with hairs.
† Remarkable hairs.

,, 2.—Mouth of *Notaspis bipilis*, seen from beneath; *p*, palpi; *mx*, maxillæ (probably not homologous with the maxillæ of winged insects); *ch*, chelæ (possibly mandibles).

,, 3.—One-clawed foot of *Hoplophora ferruginea*.

,, 4.—Three-clawed foot of *Notaspis bipilis*.

,, 5.—Single chela, extracted from the mouth, and viewed sideways.

Reviews.

ENOCK'S ENTOMOLOGICAL SLIDES.

We have much pleasure in acknowledging the receipt of some of Mr. Enock's excellent Insect-Preparations, which we very cordially recommend to all students of Entomology. The insects are mounted without pressure; and while retaining their perfect form, have lost but little (if any) of their natural colour—

just sufficient, in fact, to permit their internal anatomy being well made out. He has requested us to draw attention to the fact of his having just removed from London to Ferndale, Woking Station, Surrey, and we trust that he may there meet with greater facilities for obtaining an abundant supply of the "material" which he is so well able to utilize.

ELCOCK'S TYPE-SLIDES OF FORAMINIFERA.

THESE Slides are marvels of manipulative skill. Each slide contains 50 species, neatly arranged in squares, with the name of each species photographed in good readable type above its respective shell. A clearly-printed and arranged Catalogue accompanies each slide to assist in the finding of any special form, should that be necessary. As each species is represented in most cases by two or three specimens mounted "front," "back," and "side-view," we consider that these Slides ought to be in the hands of every student of the Foraminifera; and for our own part can only say that we should not like to prepare them for twice the price at which they are sold.

Reports of Societies.

We shall be glad if Secretaries will send us Notices of the Meetings of their Societies. Short abstracts of Papers read, and principal Objects exhibited, will always be acceptable.

EALING MICROSCOPICAL AND NATURAL HISTORY CLUB.

THE fifth Annual Conversazione of this Club was held on April 29th, and was largely attended. The objects exhibited were both valuable and numerous, but the special feature of the meeting was a large collection of the living and dead forms of Hydroida and Polyzoa, ranged along one side of the room, and including living specimens of *Clava squamata*, *Sertularia pumila*, with many others. They were accompanied by enlarged drawings of several species, one set of these showing the various phases in the life-history of *Hydra tuba;* also, by a large Album containing many well-mounted specimens, and a copy of

Ellis's "Essay on Corallines." A short paper on the subject by Dr. G. D. Brown, President of the P.M.S., was distributed freely about the room, and has been kindly sent to us for publication. It will be found on page 73 of the present number.

GREENOCK NATURAL-HISTORY SOCIETY.

At a meeting of the above Society, held in the Watt Museum Hall on Thursday evening, Mr. M. F. Dunlop read a paper entitled "Notes on the Rotifera." He remarked that Rotifera appear to have been discovered about the end of the seventeenth or beginning of the eighteenth centuries. Leuwenhoek, a Dutch naturalist, was usually credited with the discovery in 1702; but in the "Philosophical Transactions" for 1696 a description is given of an animalcule observed in 1694 by Mr. John Harris, an English naturalist, which Mr. Saville Kent in his new work on the "Infusoria" recognises as the common Rotifer. As to the peculiar wheel-like organs which give the order its name, the early observers believed that two toothed wheels were placed on the front of the little animal, and were rapidly revolved on their axes. But they were unable to conceive how such a movement could consist with parts maintaining an organic connection between themselves. Mr. Dunlop quoted from various works showing the slow process by which the idea of mechanical wheels was got rid of, and the idea adopted that the "motion" was an optical illusion produced by the vibratory movement of the cilia, with which the organs are furnished. He stated that the Rotifera were all microscopic, the largest in size not exceeding 1-36th of an inch, the smallest being only the 1-500th of an inch. He then gave a brief description of their structure, referring to their various organs—the mastax, stomach, respiratory tubes, etc., and to their nervous and muscular systems. After alluding to the difference of opinion which existed as to the position of the Rotifera in the animal kingdom, Huxley and others classing them under the Annuloida, and Gosse and others thinking that they deserved a place amongst the lower Crustaceans, he concluded by describing the classes and families into which the order is divided by Ehrenberg; and, with reference to one of the species—*Anuræa longispina* (size, 1-40th of an inch)—he mentioned that it was new to science in 1879, having in the beginning of that year been discovered by Professor Kellicott, Buffalo, U.S., in Niagara water. In the same year, in July, it was found by Mr. Levick, in Olton Reservoir, near Birmingham, Dr. C. T. Hudson, an authority on such subjects, identifying the Rotifer as the same as that found in

America. He further mentioned that about a fortnight ago, in examining a gathering taken from Murdieston Reservoir, he found what he took to be this new species, and thinking it might be interesting to record its being found in this locality, he forwarded a specimen to Mr. Thomas Bolton, of Birmingham, for identification, who has written to say that it is certainly *Anuræa longispina.*

Correspondence.

The Editors do not hold themselves responsible for the opinions or statements of their Correspondents.

To the Editor of "The Journal of the Postal Microscopical Society."

DEAR SIR,—

As I occupy (though, I fear, very unworthily) the position of President of our Society for the current year, I cannot refrain from offering you my best congratulations on the successful issue of the first periodical portion of our Transactions.

There cannot be any possible doubt in the minds of any of the members of the P.M.S. as to the existence in the "Notes" of a large quantity of material, from which may be usefully selected for publication most valuable information on practical microscopy.

Our archives are rich in notes and illustrations from the hands of our late honoured President (Mr. Tuffen West), Mr. A. Hammond, Mr. Chas. Elcock, and others.

I hope the Editor will be able to make use of this valuable material, as I am sure that "The Postal Microscopical Journal," enriched by the notes and illustrations I have spoken of, will command a high position among microscopists.

With best wishes for the success which I believe the Journal deserves,

I remain, dear Sir, yours truly,

Ealing; May, 1882. GEO. D. BROWN.

To the Editor of "The Journal of the Postal Microscopical Society."

DEAR SIR,—

I would ask permission to make a few remarks relative to a "New Series of Living Specimens for the Microscope," which is advertised on the covers of this Journal.

Having taken a lesson from my experience during the past

few years whilst in business as a professional microscopist, I purpose in this "New Series" to give my subscribers the benefit of the same.

In order to devote the whole of my time and energy to the packing and posting of specimens, I appointed a staff of collectors residing in various parts of the country, who kept me supplied with the best objects their respective neighbourhoods afforded; and by this means I have from time to time been able to supply "local objects" of great interest, which but for this arrangement would have been seen only by a very few.

But as soon as the "New Series" gets into working order, I shall have collectors throughout the whole of the United Kingdom, and also on the Continent. Indeed, I have already imported, experimentally, specimens from different parts of the Continent with much success.

The number of subscribers at the price named is limited to 400: of these a large proportion has been obtained, and so soon as this number is made up, I shall issue drawings and descriptions of the specimens with each tube.

The Hon. Sec. of the P.M.S. has kindly undertaken to receive subscriptions, which should be sent to him at once to avoid disappointment; and hoping for the co-operation of your members and subscribers,

I remain, Sir, yours truly,

Leeds. E. Wade-Wilton.

To the Editor of "The Journal of the Postal Microscopical Society."

Sir,—

Referring to the note which Mr. Edwards has written on the section of cat's tongue, I should like to ask whether it is not more probable that the papillæ were designed to enable the animal to lap up fluids, rather than "to play the part of a rasp, as in scraping bones." The former opinion is confirmed by the shape of the papillæ, which a microscopical examination will show are concave towards their extremities, and therefore adapted for supplying the animal with drink. Will you kindly permit me to ask also, what is the best method of injecting a cat's tongue?

A. J. D.

To the Editor of "The Journal of the Postal Microscopical Society."

Dear Mr. Editor,—

I congratulate you on the form and size of the Journal, and still more on its contents. A better method of publishing

the more valuable articles in our note-books could not have been found.

The illustrations are very good. I did not think that you would have attained to coloured drawings.

The omission of the border-lines would perhaps improve the plates.

Yours very truly,

Castle-Cary. C. P. COOMBS.

Information has been asked for, by a correspondent going to India, regarding the best modes of mounting and preserving Microscopic Objects in that and other similar climates. Where the normal temperature ranges between 80° and 100° Fahr., or even higher, it is evident that the ordinary methods employed in this country will not suffice. Balsam will never harden properly, and fluid media will soon find their way through the cements and varnishes in common use here. Will some of our readers who have been in those climates, or who have given attention to the subject, kindly furnish us with the results of their experience?

Editor.

EXCHANGES.

Notices are inserted in this column free of charge:—they should not exceed 5 lines in length, and must reach us at least 3 weeks before date of publication.

I have about Four Dozen Duplicate Slides, which I shall be glad to exchange with any member; they are very various.—Colonel Basevi, Elm Lodge, Prestbury, Cheltenham.

For Exchange, over 12 Doz. Micro. Slides. Wanted, other Slides, Shells, Natural-History Objects, and Scientific Books, etc.—Send for List to J. A. Ollard, F.R.M.S., Ye Hermitage, Forty Hill, Enfield, Middlesex.

SALE COLUMN.

Advertisements by members and subscribers are inserted here at the rate of SIXPENCE *for 20 words, and* THREEPENCE *for every additional 10 words or portion of 10.*

Microscopic Objects for Mounting. Fifty preparations accurately named, 2/6. R. H. Philip, 4, Grove Street, Stepney, Hull.

NOTICES TO CORRESPONDENTS.

All communications should be addressed to "Editor," care of Mr. A. Allen, 1, Cambridge Place, Bath. They must be accompanied by the name and address of the writers, but not necessarily for publication.

W. T. A.—The title of the book you enquire for is "The Story of our Museum, showing how we formed it, and what it taught us." By H. Housman. 2/6. Pub. by "Christian Knowledge Soc."

PHONOGRAPHER.—"How to Work with the Microscope," by Beale. 6th edition (just published), price 21/-. Pub. by Harrison.

Chas. Elcock.—Your second paper will appear in our next.

E. Lovett.—Thanks for your paper, which shall have early attention.

T. Barrett.—Many thanks for your help kindly given to the drawing.

Communications received from J. S., A. B., J. V., W. S., W. J. D., J. S. H., J. B., T. B. S., J. B. J., A. D., T. P., C. N.

The Journal

OF THE

Postal Microscopical Society.

SEPTEMBER, 1882.

On the Embryology of the Podophthalmata or Stalk-Eyed Crustacea.

BY EDWARD LOVETT.

HAVING recently had an opportunity, extending over a period of about eighteen months, of examining a large number of the stalk-eyed forms of Crustacea, collected from a variety of localities and depths, I noticed some interesting features with regard to the ova of these animals that seemed worthy of attention.

In the first place, several species were with ova, whilst others from the same locality were not; secondly, some species were with ova at periods totally different from the time recorded by authors on this subject; thirdly, the ova of various species were, as regards their size, out of all proportion to the ova of other species; fourthly, the protective power of the parent differed widely in species living under various conditions; and fifthly, the ova themselves underwent great changes in appearance as they approached maturity.

As regards the first of these facts, it would appear probable that many species may be double-brooded; and although I have noticed

that it is during the early summer months that ova are generally carried in the immature state, yet there are many species that are later, and others that are earlier than this. In May I obtained the ova, in an immature state, of *Portunus marmoreus*, *Palæmon serratus*, *P. squilla*, *Portumnus latipes*, *Gebia deltura*, *Scyllarus arctus*, *etc.* I had, however, already obtained the ova of several species in January, February, and March. In September I obtained the mature ova of *Xantho florida*, *X. rivulosa*, and *Achæus Cranchii*, and in December the semi-mature ova of *Hyas coarctatus*. It thus appears that the spawning season extends, in different species, over the whole year; and that more or less favoured localities, causing a variation in the spawning season of particular species, may account for the discrepancy to which I have referred in the second place.

Taking as an example a species of somewhat wide distribution, I have found that specimens from the South-west parts of the English coast, and from the Channel Islands in particular, attain to a more developed condition in many ways; and it is thus that we find species with ova in such favourable localities, at a time when the same species from the Thames estuary or the North-east coast would be without any; hence possibly arises the difference in time recorded by various authors as to the spawning-season of one and the same species.

Not only does this variation obtain under these conditions, but the geological features of a district have a most marked result upon the life inhabiting it; for instance, the protected rocky caves and chasms, or the *Zostera*-covered pools of a granitic locality are far more conducive to the development, in every way, of a species, than the cold and unfriendly clay shores of the estuaries of the Thames or Medway, or the cretaceous ledges of the south-east coast; hence we find the ova or Zoœa stages of Crustacea in a more advanced state in the former localities than in the latter.

We have next to consider the remarkable disparity that exists in the *size* of the ova of some species as compared with others.

To take a familiar example. The eggs of the common lobster, *Homarus marinus*, are three times the size of those of the spiny lobster or cray-fish, *Palinurus quadricornis*, although the

latter animal exceeds the former in size. Besides this marked example, there are numbers of others; the ova of all the *Palæmonidæ*, or prawns, are far larger in proportion to the size of the animal than the ova of any of the *Brachyura;* and those of the "burrowing shrimp," *Axius stirhynchus*, an animal only three or four inches in length, are even larger than those of the spiny lobster, which is usually over a foot in length.

It would seem, however, that the size of the ova may to some extent be regulated by the same law that regulates the protective power which the parent Crustacean is able to afford to its ova during development. This, I think, depends, if not entirely, at any rate to a great extent, upon the conditions under which the animal exists; so that a deep-water species of sluggish habits, or a species that passes most of its life either in sand-banks or mud-banks, will have larger ova with a smaller amount of protection than a species living on the shore, subject to the rough treatment of the surf, or one swimming near the surface, and exposed to the disturbing influence of the waves and wind. As examples of this, we find that the protective segments of *Corystes cassivelaunus*, a Crustacean inhabiting loose sand in deep water, are by no means so developed as those of species which exist under a less quiet condition of things,—those of the *Portunidæ*, or swimming crabs, being very broad, and thus capable of affording the necessary protection to the spawn carried beneath. Again, we find that when the abdominal segments are broad, the ligatures by which the ova are connected together, and to the base of the swimmeret, are more slight than when those segments are narrower, in an animal existing under equally favourable conditions.

The protection referred to consists in the BRACHYURA of broad, pear-shaped somites which, as we have seen, fold beneath the sternum; when the ova are exuded, they are covered by this shield, and are besides defended by the beautiful fan-like swimming-feet, which also circulate the water through the mass of eggs. Among the ANOMOURA, the hermit-crabs, *Paguridæ*, living as they do in the dead shells of Mollusca, obtain this somewhat remarkable and artificial protection for their young. The MACRURA, having the abdominal somites developed into arched processes,

are furnished with a double row of swimmerets between which the ova are securely carried; and the ova in this tribe are usually attached by very strong ligatures, thus obtaining additional protection.

We will now briefly consider the ova or spawn of these animals, noting any particular points of interest that present themselves in certain species.

The usual form is spherical, but there are exceptions to this rule, for the ova of the *Crangonidæ* are oval in shape, whilst those of the *Paguridæ* are slightly so, but closely approaching the circular form, as also are the eggs of *Homarus marinus.*

The colour is generally golden, pale brown, or of an amber tint; and it is worthy of remark that the colour of the ova is certainly regulated to some extent by that of the parent Crustacean. For example, the ovum of *Portumnus variegatus*, an animal of a pale tawny tint and inhabiting sand-banks, is of a very light straw colour;—that of *Xantho florida*, an animal of a warm reddish-brown tint, is rich golden;—and that of *Carcinus mœnas*, an animal of a very variable tint, but usually of a brownish green, is precisely similar in colour to the parent.

There are, however, one or two remarkably striking exceptions to this rule; the ova, for instance, of *Pandalus annulicornis* (the Thames "red shrimp") are of a brilliant blue-green tint, and those of *Pasiphœa sivado*, an almost ivory-white Crustacean, are of an aqueous colourless appearance.

The manner in which the eggs are exuded, and arranged in symmetrical groups on the swimmerets, is difficult to ascertain, and as the females of most species retire either to deep water or to hiding-places at this period, very little is known on this point; but if we remove one of the swimming-feet and a group of ova from the abdominal segments, and examine them under a low power of the microscope, by means of dark-ground illumination, we shall find that the basal joint or coxopodite of the swimmeret supports, as well, a transparent stalk branching out into smaller and still smaller processes; and at the end of each of these minute stems is fixed an ovum, so that each swimmeret thereby protects one bunch of ova, and supplies the young with oxygen by

setting up a current of water through them. An ovum, when newly deposited, is found to consist of a colourless transparent envelope full of transparent fluid of a tint varying, as we have seen, in different species. This envelope, or membrane, is continued into a strong viscid ligature, which is apparently twisted; and as these ligatures unite they become stronger and thicker, ultimately forming the stout peduncle which attaches them to the basal joint of the swimmeret, and which supports the whole group.

The first indication of the development of the egg is the granular appearance that the yelk assumes, and its separation from the envelope; gradually the outline of the enclosed Zoœa becomes defined, and the yelk is then enclosed in the large cephalo-thorax.

At this stage the most prominent feature is the eye, which gives the ova a most remarkable speckled appearance, even when seen without the aid of the microscope.

In the mature egg the abdomen of the Zoœa is closely folded on the sternum of the cephalo-thorax, and the limbs lie in close contact with the antennæ, antennules, and mouth organs. When the Zoœa leaves the egg the envelope of the latter is simply a collapsed and crumpled membrane, and in this respect resembles the ova of many of the Lepidoptera.

The larval, or Zoœa, forms of the stalk-eyed Crustacea are most remarkable in structure, and until a comparatively recent date were regarded as a distinct order of animals, or rather as allied to the ENTOMOSTRACA. When first hatched their eyes are sessile, their cephalo-thorax large, more or less round in form, and, in many genera, armed with large curved spines. The abdominal segments are long and simple, terminating in a remarkable filamentous tail; the Zoœa of *Lithodes maia* is particularly curious in this respect, its tail development presenting a broad, fan-shaped expanse of branching filaments of most delicate and beautiful structure. The swimming feet are absent, but the ambulatory feet are developed into limbs armed with setæ, thus supplying the necessary natatory organs; as the true swimmerets appear, these others gradually assume the structure of walking-appendages.

These larval forms, in successive moults, assume the eyes fixed

on peduncles and the other characteristics of the fully-developed animal.

It is very remarkable that, unlike the Lepidoptera and Coleoptera, the Crustacea arrive at their final stage before they can be said to have grown at all. If we take any of the insects, we find that all the growing takes place during the larval state; whereas, if we take as an example the common edible crab, *Cancer pagurus*, we find that it reaches its final stage when very minute. I have frequently taken it, developed, a quarter of an inch only across the carapace; and yet this species sometimes attains a weight of 12 lbs., so that the amount of growth that takes place during the Zoœa form, as compared with the crab form, is very small.

There is no doubt that these curious Zoœa forms constitute the food of numerous fishes as well as other marine animals, and that millions upon millions of them are thus destroyed; were this not so, the sea bottom could not afford standing room to the various Crustacea that would be produced, for the number of eggs deposited by one individual is something astounding. There seems, however, to be a wide difference in the proportionate numbers produced by different species; and it would appear as if those species whose young are more especially liable to this destruction were more prolific than those whose young are not so liable, owing to their different mode of existence.

For examination by the microscope these objects afford a wide and comparatively new field; and apart from the amount of information which they furnish to the student of zoology, particularly on that part of the subject which refers to the embryo stages, they are also specially interesting on account of their great beauty when shewn by means of dark ground illumination, as also on account of the remarkable structure of the developing Zoœa form of the animals.

In order to obtain the desired means of examination, it is necessary, with such delicate organisms, to preserve them in such a manner as shall retain their living appearance and form; and at the same time enable them to be mounted for microscopic examination, not only temporarily, but for future reference. This

it is quite possible to do, but there are a few species the ova of which do certainly lose some of their living colour, the most notable being *Pandalus annulicornis*, whose eggs are of a remarkable turquoise blue. This colour it is at present impossible, under preservation, to retain.

The method of examination best adapted to these objects, in order to define their structure and make out their general form, is by means of the Binocular Microscope with a 1½-in. or 2-in. object glass, No. 1 eye-piece, and either parabola or spot-lens; if, however, the ova be small, or it is desired to examine more minutely the structure of any part, a higher power with different illumination may be resorted to. If, after suitable preparation, they be thus examined, they will be found not only to have retained their rotundity and natural appearance, but it will be quite easy to discern the limbs, pigment cells, tail appendages, etc., of the mature Zocea, though still enclosed in the egg-envelope.

The Adulteration of Coffee and the Microscope.

By J. S. Harrison, F.R.M.S.

Plate 11.

In the small town in which I reside, I happen to know the possessors of several microscopes, who do not put their instruments to any practical use, and I have no doubt such is the case also in many other parts of the country; so that a large amount of microscopic power lies dormant, merely for the want of knowing what to do with it. In the hope, therefore, of partially removing this want, I would point out to our unprofessional and non-scientific friends an interesting and practically useful direction, in which to employ the few leisure moments they may be able to devote to their instruments.

The adulteration of the Foods and Drinks which we daily consume, and on which our bodily health so much depends,

although not so openly and flagrantly carried on as it used to be (thanks to the "Adulteration of Foods' Act"), is still practised to a very large extent. As science brought its powers to bear on the discovery and detection of adulterations, so did the would-be defrauders engage science also on their side; hence there is, in reality, a lasting conflict between science and science: just as our Admiralty build armour-plated vessels to withstand the penetrating power of the heaviest guns, which is no sooner done, than some clever inventor produces a still heavier gun, which shall once more penetrate the ship.

Perhaps no article of daily consumption in our homes is more open to the practice of adulteration than Coffee; and an epitome of the facts of a case relating to this subject, which appeared in a local paper a few weeks ago, may not be without interest to our members as microscopists, while it will also serve as a fitting introduction to my subject.

A sample of Coffee, purchased from a grocer, was submitted to the public analyst, who certified that the coffee contained a large admixture of chicory; and he felt sure that he could not possibly have made a mistake, since he had twice tested the coffee, *analytically*, with precisely the same result down to a millegramme. So certain, however, was the defendant that the coffee was *not* mixed, that he put in two certificates from other public analysts, who declared the coffee to be pure; he also produced a paper from Somerset House, signed by Messrs. Bell Bannister and Harkness, certifying that the coffee was pure and free from chicory. The case was accordingly dismissed, with costs against the Corporation.

I am of opinion (open to correction) that there is no *chemical* process by which the adulteration of coffee with chicory can be undeniably proved. I know that the ash of coffee and of chicory differ materially, both as to quantity and as to their behaviour under different re-agents, and on this fact many analysts base their results; but I would ask, is no other adulterant than chicory ever used? I am afraid that many are:—even chicory itself is largely mixed with other things, and pure chicory is almost as difficult to obtain as pure coffee.

Where Chemistry fails, the Microscope steps in; and now most of our public analysts put as implicit faith in the revelations of the microscope as they do in their chemical processes. Had the unfortunate analyst in question appealed to his instrument, it would have told him with absolute certainty, whether or not any chicory existed in the sample of coffee.

The examination of coffee is a simple matter, and may be accomplished by the most unpractised microscopist. After

intimately mixing the sample, place a small quantity in a test-tube with a few drops of Liquor Potassæ; boil for a few minutes, and when it has cooled, pour off the potash and wash the residue well several times with distilled water. After washing, spread a small portion on a glass slip; with a needle-point pick out any small hard pieces which might break the cover-glass, and such as you may be pretty certain are pure coffee; whilst picking these out, observe whether there are any small, soft, jelly-like pieces; if so, you may be equally certain they are chicory.

Now cover with thin glass, and examine with a half-in. or quarter-in. objective.

The Coffee-berry is made up of two distinct parts:—the substance of the berry, and the testa, or membrane, by which it is surrounded.

The substance of the berry consists of vesicles, or cells, of an angular form, which adhere so firmly together that they break up into pieces rather than separate into distinct and perfect cells. The testa, or investing membrane, presents a very different structure from that of the berry itself, and if once fairly recognised cannot be confounded with any of the structures found in chicory, or in the other adulterants of coffee. It is made up principally of elongated and adherent cells, forming a single layer, and having oblique markings upon their surfaces; and these cells rest upon another thin membrane, which presents an indistinct and fibrous structure (Pl. 11, Fig. 3). In the groove which runs along each berry, a few small vessels, each formed of a single and continuous spiral thread, may usually be found.

In the Chicory root, four parts or structures may easily be detected,—cells, dotted vessels, vessels of the latex, and wood-fibre (Fig. 1). The bulk of the root consists of small cells, generally rounded, but sometimes narrow and elongated. The dotted vessels are particularly abundant in the central and harder parts of the root, which they traverse in bundles; they are cylindrical, unbranched tubes, tapering to a point at either extremity, and marked on the surface with short fibres that describe an interrupted, spiral course.

The vessels of the latex, *vasa laticifera*, form branched and frequently-anastomosing tubes, of smaller diameter than the dotted vessels, and with smooth membranous walls. The woody fibre of chicory-root does not present any markings or other peculiarities of a special character.

These, then, are the distinctive differences between Coffee and Chicory; and if the amateur microscopist will make himself thoroughly conversant with the two substances in their pure state, he will be able to pronounce at any time with certainty,

whether any sample put before him contains them both in admixture, or whether it is unadulterated.

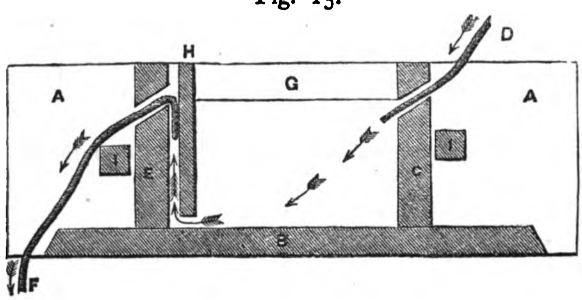
EXPLANATION OF PLATE XI.

Fig. 1.—Portion of Roasted Chicory, showing dotted vessels and cells.
,, 2.—Portion of seed of Roasted Coffee.
,, 3.—Portion of Membrane of Coffee-Berry.
,, 4.—Sample of Coffee adulterated with Chicory.

A New Growing-Slide.

AT a recent meeting of the Royal Microscopical Society, a new form of growing-slide,—intended for the examination of minute aquatic organisms,—was exhibited and described by the inventor, Mr. T. Charters White, M.R.C.S., F.R.M.S. The ordinary glass slip need not here be used at all, but the organisms should be at once placed—with a little water—on this Slide, when all that is needed to maintain a constant current through the cell is the insertion of small threads of cotton into openings in its sides. The organism is thus duly nourished, and its normal development not being interfered with can be readily observed at any time from day to day. The annexed drawing and

Fig. 15.



description of this useful Slide are taken with the kind permission

of the Editor from the current volume of the Royal Microscopical Society's Journal, page 19:—

"It consists of the usual glass slip, A A (3 in. by 1 in.), having a narrow ledge of glass, B, about ⅛th of an inch wide, and extending nearly its whole length, fastened to its lower border with marine glue; to this is cemented at right angles a strip of thin covering-glass, C, about ¼ of an inch wide, and at about 1⅛th inch from the end of the slide, having a narrow channel cut through it for the passage of an intake thread, D. A similar strip, E, having a similar cut through it for the passage of an outlet thread, F, is cemented at the same distance from the opposite end of the slide. In order that organisms near the bottom of the cell may be benefitted by a constant change of water, a very narrow slip, H, of the same thin covering-glass is cemented to the inner side of the outlet end of the cell, commencing at the top of the slide and extending very nearly to the bottom, so as to leave only about $^1/_{16}$th inch between E and H. If the intake-thread is now connected with a bottle of water placed above the level of the slide, water entering by it will pass in a diagonal direction from D to the left and bottom of the cell, where the suction set up by the siphon-like action of the outlet thread makes itself felt, and there is a regular current in the direction of the arrows.

The front of the cell is formed of a piece of thin cover-glass of 1½ inch by ⅝; and two small square blocks of glass, I, cemented on each side, will hold this cover-glass sufficiently firm to prevent it sliding on the organism and crushing it.

Such a Growing-Slide will hold about one drachm of water, and taking the rate of the drops from the outlet-thread as about one per minute, the whole of the water will be changed once every hour; while at the same time the current is not strong enough to carry away any but the finest and lightest particles. It allows of fair observation with a ¼-inch objective."

Another very simple plan was suggested at the same meeting, which consisted in making a small cell of the ordinary thin covering-glass, and then surrounding it with blotting-paper, which must be kept constantly wet; by this means, large monads might be kept under continual observation for three or four weeks.

Spiders: Their Structure and Habits.

By William Horner.

Second Paper. Plate 12.

THE webs of the *Retiary* Spiders have each a distinct character, so much so that you can tell by inspection to what family a given web may belong, and, indeed, in many cases they betray even specific differences. However, not to enter too much into detail, it will suffice to remark that some exhibit an irregular network of lines in all directions, and in different planes; others resemble a horizontal sheet of fine webbing, supported by its margin, and secured by fine lines running from various parts of its surface, both above and below. Others, including those of the domestic spider, are large and close-textured; and when in the corners of buildings, contain a tubular hiding-place for the proprietor, placed in the angle formed by the walls.

There are some webs, however, which deserve a more detailed description, especially those of the *Epeiridæ*, sometimes called the Geometric Spiders, from the symmetry and regularity of plan which characterizes their work. They usually suspend their nets in an oblique or vertical position on shrubs or buildings; and their first operation is to enclose an area, no matter of what figure, with threads of sufficient strength. This is done by walking round the space destined for the snare, and laying down threads from point to point, until it is enclosed by straight lines forming an irregular polygon. Should the spider meet with inaccessible openings in the course of her walk, she has more resources than one. She may drop a perpendicular from one spot to another, or she may swing herself across by the aid of a breeze, and so reach a convenient spot. Should this be impracticable, she proceeds as follows:—She has no power to eject a thread from her body in whatever direction she pleases, but she avails herself of currents of air, and on their wings sends out her lines to astonishing distances. But inasmuch as her threads, when entire, are too heavy to yield to a moderate breeze, while the separate strands which compose them are moved by the slightest breath, she uses her spinning-tubes separately: emitting their liquid gum, and turning her face to the wind, she allows it to be

drawn out and floated on the current, until the delicate filaments attach themselves to some object. Using this temporary line as a bridge, she travels along it, replacing it as she goes by an entire thread. The boundary lines being thus laid down, she now attaches a thread to one of them, and crossing to the opposite side fastens it there, so as to form a diameter. Reascending to the middle of this line, she then attaches a new thread, conveys it back to the margin and along the boundary, (guiding it all the way by her hind feet so that it may not get entangled,) and then fastens it to some point to serve as a first radius. Along this radius she returns to the centre, doubling the thread on her way to strengthen it, and thence proceeds in the same manner to lay down 20 or 30 more radii. These, as well as the boundary lines, are all plain threads. She then returns to the centre, and lays down a spiral line from it to the circumference, intersecting all the radii. These are also plain threads, but finer than the former; and they serve a temporary purpose only, viz., to afford her a foot-hold while she draws a spiral line of *viscid* threads from the circumference to the centre, which is to form the most important part of the snare. The plain spiral threads she bites off so soon as she has done with them, just as any other builder removes the scaffolding when it has served its purpose. The *viscid* spiral is not continued quite up to the centre, but a central space is left, closely covered with plain threads. From this she spins a line of communication with her retreat, near the confines of the web; and by the vibrations of this line she is promptly informed of the arrival of visitors.

It will have been noticed that in the process above described the spider has often to walk along two sides of a triangle in laying down the third side, or in order to reach a destined point by a circuitous route. In such cases, one might expect to find a slack line, but it is not so—they are invariably tight. This result she accomplishes by pulling at the non-elastic threads with her pectinated claws, and so tightening them. The elastic threads adjust themselves to any diminution of distance between their extremities: (as may be seen in a piece of ordinary elastic, which after being stretched to perhaps a foot in length, reduces itself to a few inches on being let go). This elasticity of the *viscid* threads also enables the web to adapt itself to frequent and sudden shocks from the wind, or from the struggles of captured insects.

Such are the webs of the *Epeira diadema*, or "Garden Spider," known by its hunchback and the distinct cross on the upper side of the abdomen. Another species, the *Epeira calophylla*, employs a radius of its web for a pathway, and thus gives the snare an unfinished appearance; as the spaces between this and the two

adjacent radii are left open to prevent the spider from being caught in her own net. The *E. inclinata*, so called from the oblique position of its web, bites away the tuft which united all the radii at the centre, and takes her station near the circular opening thus formed. She extemporises a line of retreat wherever required, lowering herself to the ground by a thread fastened to the innermost spiral, and re-ascending by it when the coast is clear.

Our admiration of these webs, so true in all their proportions, is increased when we consider that they are executed entirely by the sense of touch. The eyes of spiders are so convex that they can discern objects only at very small distances; it is, therefore, unlikely that they can be of much service in guiding the movements of organs so remote, and so much out of the line of sight, as are the hind feet and the spinnerets.

It is moreover a well-ascertained fact that webs spun by the *Epeiridæ* in the dark betray no irregularity of plan, nor imperfections of workmanship. An instance came under my own observation last autumn.

It is an interesting question how these different kinds of thread are produced from the same spinning apparatus. We have noticed in the web of the *Epeiridæ* three distinct threads,—one differing from both the others in being adhesive and highly elastic. Now, examination proves that the former property, the stickiness, is not inherent in the thread but in the *globules alone;* for when these are carefully removed the thread is left perfectly unadhesive, while yet retaining its elasticity. These, therefore, must be the product of a different kind of secretion from that which produces the threads; for the latter possess indeed ductility in a high degree, but are unadhesive, while with the globules the case is exactly the reverse. We have therefore to account for four, if not five, distinct products, viz.—three kinds of thread, the viscid globules, and the liquid gum or solder, used by all *Retiary* spiders in fixing their threads.

The supply of viscid material in the spinning apparatus of the *Epeiridæ* must be considerable; for according to the calculations of Mr. Blackwall, the number of globules in a Geometric Spider's web of average dimensions, is not less than 87,000, while in a large web of 14 or 16 inches diameter, they must amount to near upon 120,000.

To assist our inquiries the microscope furnishes us with the following data respecting the spinning-organs :—

(1)—In the Retiary Spiders the spinning tubes are far more numerous than in the Hunting Spiders; and this is pre-eminently the case with the *Epeiridæ*, the total number exceeding 1,000 in a

specimen of this genus that weighed only about 20 grains. This is precisely what we might have expected,—that nature has been careful to proportion the supply to the demand, here as elsewhere.

(2)—In the same class of spiders the spinning-tubes are very unequally distributed among the three pairs of spinnerets,—being far more numerous, and at the same time more minute, on the lower pair than on the upper and intermediate ones.

(3)—The lower pair in all spiders have two spinning-tubes much larger than the rest; and in the *Epeiridæ* the upper and intermediate pairs also have each two or three that are larger, and of different shape from the others.

(4)—In all cases the silk-glands are larger or smaller according to the size of their respective tubes.

From the unequal distribution of the spinning-tubes we might conjecture that all the pairs of spinnerets have not the same office; and when we observe that the *Epeiridæ* and others, which spin three varieties of thread, have three pairs of spinnerets, and that the *Ciniflonidæ* (to be noticed presently), which spin four varieties of thread, have four pairs, we seem naturally led to the conclusion that each of the different sorts of thread which contribute to the composition of a web, is the separate formation of one pair of spinnerets, specially adapted for that one thread.

Connecting facts 3 and 4 with the large supply of viscid material requisite for the wants of an *Epeira*, there appears to be ground for assuming that the five large glands and spinning-tubes attached to the upper and intermediate pairs of spinnerets furnish the adhesive liquid, and apply it as a varnish to the elastic threads drawn out from the lower pair. It would then run into dots or globules, like moisture on a hair, by the attraction of cohesion. The liquid gum used for soldering purposes may likewise be the special product of the two large glands and tubes, always present in the lower pair of spinnerets.

The feet of the Retiary Spiders are beautifully adapted to their office of rope-walking and rope-making. They need no scopula, but are provided with three principal claws at the extremity of the tarsus, and several secondary ones on its under side, all being pectinated (Plate 12, Fig. 7). In some species of *Epeira*, as many as five of these secondary claws may be counted, and their office is obviously to guide the threads drawn out in traversing their complicated webs, so as to prevent entanglement. Many of the *Epeiridæ* have also a strong, movable spine inserted near the end of the tarsus of each hind leg, on the under side, which bends abruptly upwards at its extremity towards the claws. This serves the office of a thumb, and with the claws gives the foot a firm grip of that thread by which the creature suspends itself.

Was this known to Solomon when he wrote, "The spider taketh hold with her hands, and is in kings' palaces"?

Inferior in interest to the *Epeiridæ*, but worthy of more than a passing notice, on account of certain peculiarities of structure, and the singularity of their webs, are the *Cinifionidæ*, or Hair-Curlers. The *Ciniflo atrox*, one of the best representatives of the family, is a very common spider, from ¼ to ½ inch long: it frequents crevices in old walls, or the branches of trees growing against walls, and spins a web of somewhat close texture and woolly appearance, with a funnel-shaped passage of thin silk conducting to its retreat.

The *Ciniflonidæ* have two peculiarities in their structure:—

(1) They have four pairs of spinnerets (Plate 12, Fig. 3). The upper pair are three-jointed and longer than the rest; the two intermediate pairs are two-jointed; while the fourth pair are the shortest of all, and are situated beneath the lower of the two intermediate pairs. They consist of a single joint only, and are sometimes connected throughout their entire length; they are conical in figure, but truncated, so that their appearance is that of flat oblong plates, studded with a vast number of exceedingly minute papillæ. Those who have examined them under sufficiently high powers profess to have counted 1250 papillæ on each plate, or 2500 on the pair; whereas there are not more than 112 on the remaining six altogether—an enormous preponderance. But the minuteness of these papillæ is equally astonishing, each one being only 1—40th of the size of those belonging to the third pair, which last are smaller than those of an *Epeira*: they are, in fact, not more than 1—15,000th of an inch in diameter.

(2) The other peculiarity of the *Ciniflonidæ* is the possession of an appendage to the meta-tarsi of the two hind legs, consisting of two parallel rows of fine movable spines. These are situated on a ridge on the upper side of the joint nearest to the abdomen, commencing near the articulation with the tibia, and terminating at a strong spur near the tarsus. Those of the upper row are bent and tapering,—those of the lower stronger, closer, and nearly straight. This instrument is called the *calamistrum*, or curling-iron, and is that which contributes to the web its singular and characteristic features. A drawing of it will be found on Pl. 12, Figs. 9 and 10.

A lens of tolerably high power reveals four kinds of thread in a Ciniflo's web. First, we observe a number of fine lines, connecting various objects around the spider's retreat, and intersecting one another in an irregular manner. To these are attached flocks of filaments of a pale-blue tint, arranged both longitudinally and transversely. One such flock consists of two

thin, straight lines, with a tortuous line superposed on each; and on each of these again a pale-blue band, of such extreme tenuity that its filaments are imperceptible, even by the aid of the microscope. These blue bands impart to the web an adhesive character,—not from being glutinous, but from their fibrous nature, since they are composed of loose fibre like floss silk. These composite flocks are produced by the use of the calamistra, which are so beautifully regulated in position and movements that the points of the *lower* row of spines draw out the filaments from the tips of the spinnerets, while the *upper* row detach them by an upward movement. Each flock, as soon as completed, is fixed to one of the foundation-lines.

There can be little doubt that, in constructing this web, the *long* pair of spinnerets is used to produce the foundation-lines; the *upper* intermediate pair produce the two fine, straight lines, and the *lower* intermediate pair the two tortuous ones; while the fourth pair, with their innumerable papillæ, produce the pale-blue bands. On this hypothesis, the relative position of these various components of a flock, as well as their several characters, is best accounted for.

I have alluded to the strong maternal instinct of these creatures as an amiable feature in their character, and it may not be uninteresting to bestow some brief notice upon the way in which they exercise their parental functions.

The period of the year when the female deposits her eggs varies in different families, and embraces all the months from May to October inclusive. At the proper time she prepares a cocoon, and sometimes more than one, in which to deposit them; and these cocoons differ much in form, colour, texture, situation, and contents. Two examples of the process employed will suffice for present illustration.

The *Epeira quadrata*, in constructing her cocoon, (a single one,) presses her spinnerets against the mass of eggs, and attaches a compound line to it; then, drawing out the line by raising her body, she again attaches the spinnerets to the eggs, and cements this line to them in the form of a small loop. This operation is continued until the eggs are covered; when the lines are united and form a mass of short silken loops, giving the cocoon a loose texture.

Others of a more compact structure are fabricated in the following ingenious manner:—The mother spins a thin coating of silk, and gives it a hemispherical shape by turning her body round and round during the process. The hollow cup thus formed she fills with eggs, piling them up till they become a globe, of which the upper half is bare. Over this she spins another coating

similar to the former; and the result is a well-protected ball of eggs, whose diameter is about equal to the length of her own body. The number of eggs in a cocoon varies widely in the different species, from the *Salticus scenicus*, which lays about 15 eggs only, to the *Epeira quadrata*, with 1000 or more.

The devotion of the mother to her cocoon is beautiful. Many of the Hunting Spiders carry it about with them, attached usually to the spinnerets, but, in some cases, to the breastplate (see Plate 12, Fig. 2); and two species of Retiary Spiders, viz:—*Theridion Carolinum* and *Linyphia crypticolens*, do the same. These display the utmost tenacity in guarding their charge, refusing to part with it even when attacked by a more powerful enemy. The rest deposit their cocoons (either uncovered or enclosed in a cell) beneath stones, on the under-side of leaves, under the loose bark of trees, or in crevices of walls, etc.; and many keep watch and ward over them during the winter months.

When the young spiders issue from the egg, they are enclosed in a membranous envelope, which they do not throw off until the time when they quit the cocoon,—a period depending in part upon the temperature, but generally occurring about the months of April or May. In the case of a cocoon found by me during the month of October, under some loose bark in the fields, and kept indoors without any artificial heat through a very mild winter, I found that by the first week in February the young were all hatched, and busy filling their prison with a labyrinth of webs. A cocoon of the *Epeira diadema*, found with the mother in November, was subjected to artificial warmth from the 13th of February, and before the end of the month nearly a dozen young ones had issued from it and begun weaving with the utmost alacrity.

After throwing off their first integument on leaving the cocoon, the young spiders undergo several other moults before they arrive at maturity. The number of these varies with the species. An *Epeira* has been observed to moult five times in four months from the day of its quitting the egg; when it appeared to have reached maturity. A *Tegenaria civilis*,—one of the House Spiders, as the name implies,—has been known to moult nine times in the first fourteen or fifteen months of its existence, after which its development was complete. In these cases, it was noticed that the intervals between the moults were always much shorter in the summer than in the winter months.

Connected with the renewal of integuments is the reproduction of the limbs. If a leg, or a palpus, or even a spinneret, be amputated or mutilated, the member is found to be restored, generally with enlarged dimensions, at the next period of moulting.

Most persons will have observed on fine, calm autumn days, a filmy substance covering the fields and hedges with a confused kind of network, and rising and floating in the air in flakes varying from a few inches to several feet in length. I refer to the "gossamer," the phenomena of which have been made the subject of much marvel and mystery by poets and philosophers, and have been explained even by scientific men on various fanciful theories.

The word still remains as great a puzzle to etymologists, as the thing itself once was to naturalists. The derivations found in the dictionaries are various and unsatisfactory. Wedgwood's seems to me to be the best, who compounds it of God and summer. "God's summer" would pass into gossamer as naturally as "God-spel" does into Gospel, or "godsip" into gossip; and the idea was doubtless suggested by the names under which it is known in France and Germany:—"*fils de la vierge*" in the one, and "*Marien faden*" in the other. Both of these connect it with a tradition respecting the blessed Virgin's winding-sheet.

But whatever the meaning of the word, gossamer is now acknowledged to be the production of spiders. There are certain species, and those about the smallest of their respective tribes (*Thomisus cristatus* and *Lycosa exigua*, being only 1—6th of an inch long), which, at certain seasons of the year, and for reasons best known to themselves, are suddenly seized with an excursionist fit. Mounting to the summit of a blade of grass or the top of a gate, they emit from their spinning-tubes (which are kept separate the while) a multitude of fine filaments, invisible to the naked eye. These are drawn out and carried upwards by an ascending current of rarefied air; and uniting into flakes, they soon acquire, by the action of the current upon them, a buoyancy sufficient to support the spider, who then quits her hold of *terra firma*, and launches into the fields of air. This phenomena is never seen except under suitable atmospheric conditions: it requires a bright and calm day, the former being necessary to create a stratum of hot air near the ground, and the latter to allow of the establishment of an upward current.

By way of conclusion to these remarks upon our British Spiders, I have added a tabulated arrangement of their families and genera, with letters affixed to each genus, pointing out its most characteristic details of structure. It may, perhaps, help towards the identification of captured specimens.

I.—Tribe, Octonoculina.

I.—Mygalidæ	Atypus	*b*	*d*	*g*
II.—Lycosidæ	Lycosa	*b*	*d*	*f*
	Dolomedes	*b*	*d*	*f*
	Hecaerge	*a*	*d*	*f*
	Sphasus	*b*	*d*	*f*
III.—Salticidæ	Eresus	*a*	*d*	*f*
	Salticus	*a*	*d*	*f*
IV.—Thomisidæ	Thomisus	*a*	*d*	*f*
	Philodromus	*a*	*d*	*f*
	Sparassus	*a*	*d*	*f*
V.—Drassidæ	Drassus	*a*	*d*	*f*
	Clubiona	*a*	*d*	*f*
	Argyroneta	*b*	*d*	*f*
VI.—Ciniflonidæ	Ciniflo	*b*	*e*	*f*
	Ergatis	*b*	*e*	*f*
	Veleda	*b*	*e*	*f*
VII.—Agelenidæ	Agelena	*b*, (a few *a*)	*d*	*f*
	Tegenaria	*b*	*d*	*f*
	Cœlotes	*b*	*d*	*f*
	Textrix	*b*	*d*	*f*
VIII.—Theridiidæ	Theridion	*b* or *c*	*d*	*f*
	Pholcus	*b*	*d*	*f*
IX.—Linyphiidæ	Linyphia	*b*	*d*	*f*
	Neriene	*b*	*d*	*f*
	Walckenaera	*b*	*d*	*f*
	Pachygnatha	*b*	*d*	*f*
X.—Epeiridæ	Epeira	*c*	*d*	*f*
	Tetragnatha	*b*	*d*	*f*

II.—Tribe, Senoculina.

I.—Dysderidæ	Dysdera	*a* or *b*	*d*	*g*
	Segestria	*b*	*d*	*g*
	Schœnobates	*a*	*d*	*g*
	Oonops	*a*	*d*	*g*
II.—Scytodidæ	Scytodes	*a*	*d*	*f*

(*a*) 2 claws and scopula	(*d*) 3 pairs of spinnerets
(*b*) 3 claws	(*e*) 4 ditto
(*c*) more than 3 claws	(*f*) 2 branchial vents

(*g*) 2 branchial and 2 trachæal vents.

EXPLANATION OF PLATE XII.

Fig. 1.—Diagrammatic section of Spider's abdomen, showing the silk-glands and other organs *in situ*. *a*, Spinnerets; *b c*, Silk-glands; *d*, Pulmonary leaflets; *e*, Pulmonary chamber; *f*, Heart; *g*, Pericardium; *h h*, Vessels which return the blood to the heart after aeration; *k*, Anal outlet; *l*, Ovary containing eggs.

,, 2.—Female of *Dolomedes mirabilis*, carrying her cocoon attached to the breastplate.

,, 3.—Spinnerets of *Ciniflo atrox*, 4 pairs.

,, 4.—Ditto of *Agelena labyrinthica*, 3 pairs.

,, 5.—Long, 3-jointed spinneret of ditto, side view, showing spinning-tubes.

,, 6.—Foot of *Tegenaria civilis*, with 3 claws.

,, 7.—Ditto *Epeira diadema*, with 3 large and several subsidiary claws.

,, 8.—Foot of *Salticus scenicus*. with 2 claws and scopula.

,, 9.—Hind-leg of *Ciniflo*, with calamistrum *in situ*.

,, 10.—Calamistrum, more magnified.

Unpressed Mounting for the Microscope.

By Alfred W. Stokes, F.C.S.

BLUE-BOTTLES are still in season! At every window, with very little or very great *panes*, the microscopist, on that happy hunting-ground, may meet the buzzing monster. There are few cabinets in which "the Tongue of a Blow-fly" is not to be found; it haunts the boxes of "The Postal Microscopical Society" with painful regularity; go to any *soirée*, and you will, with certainty, through some brazen tube, see the blow-fly putting out his tongue at you. Most books on the microscope

seem to open easiest at the picture of "the tongue of a blow-fly"; they almost all have a drawing of it. And all these many tongues apparently conspire to utter the same mis-statement of fact; for how few of us have ever through the microscope seen anything but a squashed and flattened object;—a something as like the real thing as that flattened collection of dirty feathers over which several cart-wheels have passed is like the once gay rooster crowing on his own dung-hill.

Now, seeing these are serious objections to the too-common method of mounting, and suspecting that most of this distortion of Nature results from not knowing how else to preserve microscopical objects, we would lay before our readers what we consider a better, easier, and more natural method:—a plan in which, from the beginning to the end, the true shape of the object is preserved.

Let us try whether we cannot mount our "Tongue of Blow-fly," for instance, so as to see its true shape; to have it transparent in every part; to be able to view each hair, every ramification of the internal organs, tracheæ, etc., just in the positions they naturally occupy.

And, firstly, it is not necessary to wait till our blow-fly has his tongue protruded over some piece of sugar, and then deftly to cut it off with a pair of scissors. Nor need we squeeze the head to make the tongue protrude, nor pull it out with tweezers. All such methods mean the expenditure of a lot of time, and the slaughter of a number of blow-flies, with the production of a few more or less damaged and fragmentary objects. In fact, we will not cut off the tongue at all, but mount it in its natural position on the head; for our blow-fly's neck is so slender that there is no difficulty whatever in decapitating him. We will, therefore, do so. Now, if we consult our books on microscopical mounting, we find that we must first dry the head, and then soak it in turpentine; or, as some say, put it at once in turpentine and *wait* till it is transparent. If mounting anything but horses had been in vogue in Methuselah's days, such methods would have been then well worth trying; there was no need for hurry in those happy times. Those, perhaps, were the days when they placed knobs of "Wallsend" in carbonate of potash solution, and fished them out a century or so later, just nice and soft for cutting "coal sections." Alas! this is now a lost art, in spite of the plain directions given in various works on microscopical mounting! But as we cannot wait the months necessary for the blow-fly's head to become transparent (if it ever would by this process), we will try a shorter plan; for even in microscopical mounting it is of some advantage to be reasonable. And in order to make it transparent, we have first to get rid of the mass of colouring matter and of all air; since, of all

things, air diffused through an object is the most *in*-transparent,—difficult to get rid of, and misleading in its appearances to the microscopist. Most bodies contain about seventy per cent. of water; and in drying an object, therefore, we get rid of all this, partly by shrivelling up the object, partly by replacing the water with air. Then, having spent some time and effort to get the object well filled with air and nicely shrunken up, we set to work with still greater trouble to get the air out again, and to puff out the specimen to something like its former shape. Hence, whatever else we do, we will *not* dry our object. That part of the tissue of the blow-fly's head which is not swollen with water is filled with air; and so, while taking out the colouring matter, it will be an economy of time to get rid also of some of the air. What apparatus do we need for this? would not an air-pump be of use? By all means, if you can afford it, and if you wish to add another to your array of instruments, go and purchase an air-pump, and do whatever you like with it, only do not use it for microscopical mounting. Go, instead, and buy a half-penny test-tube; for a solitary test-tube is the whole of the preparing apparatus needed in this method!

Into this test-tube place the fly's head, and fill the tube half-full with a solution of soda or potash. Stand the tube in a cup or tin pot of boiling water, and leave it on the hob of a fire or other warm place to keep hot till morning. Then examine the head and see if it looks almost transparent; if not, pour off the soda-solution, and add a fresh supply, and again keep the tube hot till the object becomes semi-transparent. Now pour off the solution and add hot water, in a few minutes emptying it out and adding some more:—repeat this at least three times, and finally leave the last quantity of water on the object for an hour to cool. Next pour off all the water and replace it with spirit of wine; methylated spirit, if strong, will do sufficiently well. Heat this by immersing the tube in a vessel of hot water for one minute; then take it out, cork it up, and leave it for one hour.

So far, we have, by means of the soda-solution, destroyed all the flesh and fat-tissues, leaving only the cuticle and internal organs, such as the tracheæ, etc. In doing this, we have filled up most of the few natural air-spaces with soda-solution; which, however, being a somewhat dense fluid, would not enter many of the narrow tracheal tubes. Then with water we replaced the soda-solution, and washed away the parts destroyed thereby. On replacing the water by alcohol,—a still less dense fluid,—more of the finer air-spaces are penetrated and the air driven out: there are still, however, some tubes too minute even for alcohol rapidly to enter. So now we pour off the spirit, and add ether instead,

which answers a double purpose;—it enters readily the very minutest passages, displacing the contained air, and it also dissolves the globules of fat left unsaponified by the soda-solution. After leaving the ether for fifteen minutes in the corked tube, and shaking it once or twice, we pour it off and add turpentine; and then in ten minutes' time our blow-fly's head is ready for mounting in Canada Balsam or Dammar.

But if so mounted, it will be very difficult to see much of the finer internal structure, since these media render some parts far too transparent: and hence some of the glycerine media are preferable. In such cases, after pouring off the ether add alcohol, and at the end of fifteen minutes replace the alcohol with cold water, and leave for fifteen minutes more. Then the water may be poured off, and the mounting-fluid, whether glycerine, carbolic-acid, gelatine, Goadby's or Thwaites' fluid, may be added. The object, if mounted in any of these, will have a far more natural appearance, and show more plainly the finer structures, than if mounted in Canada Balsam. The times mentioned above are those it is *necessary* in most cases to wait, but longer intervals would often be preferable. If we are busy, the tube and its contents may be left at any stage of the proceedings for days, with a certainty that the object will only benefit by the delay; *except* in the case of the soda-solution. Of course, when the object is transparent enough, a longer stay in that solution would only render it *too* transparent, and so spoil it. It is not necessary to use distilled water, though it is better to do so; but whatever water is used, it should have been just freshly boiled and be used hot. Cold, unboiled water contains a large quantity of air, and if used in that state will certainly impart air to the object instead of helping to extract it.

The soda or potash solution is made by adding solid potash or soda to eight times its weight of boiling water.

The spirit and the ether, which have been used during the process, should be poured off into a separate waste bottle, either to be afterwards redistilled, or for use in some other way:—ether, being highly inflammable, should not be brought near a light. The only expenses are for soda, alcohol, ether, and one tube; of the alcohol and ether there is practically very little waste, as a pint of each will prepare some thousands of specimens.

So far, we have written as if it were only the blow-fly's head that we wished to prepare; but it is obvious that in the same tube we may have some dozen or more insects, or parts of insects,—only being careful to remember which is which. The same system will answer likewise for plant specimens, such as sections of wood, small seed-vessels, leaves, etc. Only in their case they should first

be decoloured by pouring Sodic Hypochlorite into the tube; then, after well washing with water, the rest of the process may be followed as before, leaving out entirely the use of the soda-solution. The great difference is in the matter of speed, as vegetable preparations can be made far more rapidly than insect ones. It is possible by this method to cut a dozen sections from a living branch,—bleach, stain, and mount them in Canada Balsam or Glycerine-solution,—and finally, ring and label them, all within the hour.

Should some of the preparations—our Blow-fly's head, for instance—become too colourless and transparent, all we have to do is to stain such by the addition of a few drops of an alcoholic solution of some colouring matter (logwood answers well) to the alcohol in the tube. The subsequent use of ether will fix the colour.

Usually after this treatment, the object will be found to be quite clean; but if not, it should be gently brushed with a camel-hair pencil while in the turpentine or glycerine-fluid. The wings of many insects are partially destroyed during the process, but since these can, if desired, be easily mounted separately, this is not of very great importance.

The next point is how to mount our objects without pressure. Small insects,—such as Ichneumon-flies and Gnats,—parts of insects, such as the legs, etc.,—leaves and other portions of plants, may be mounted in shallow cells, formed by running a ring of gold-size or "Brown cement" on the glass slip. The brown cement is very useful for this purpose, and is highly recommended where a rapidly-drying and firm cement is required. For those to whom expense is no object, the slips having cells hollowed out in the centre should be chosen.

Larger objects will need a deeper cell than any of these afford; and to form such, vulcanite rings are undoubtedly the best, as also they are the cheapest. A number of these rings, of various thicknesses, should be cemented to *ground-edge* glass slips. Let no true microscopist indulge in the paltry saving effected by using slips with rough edges. Though anyone possessed of such ultra-frugality may have the right to cut his own fingers with their sharp edges, he has no right to endanger the cuticle of his friends: and if he intends to prevent this by covering up the slide with some of the harlequin papers too often used, he will find that there is no economy in the double purchase, either in the matter of time or expense.

Having prepared a number of vulcanite cells a day or so beforehand, we select one just a trifle shallower than the object to be mounted: and if the mounting is to be in any other solution

than Canada Balsam or Dammar, we proceed thus:—The top edge of the cell we cover with a thin layer of brown cement; then we breathe into the cell, and before the moisture dries fill it up with the solution for mounting in. If we did not breathe into the cell, there would probably be an ugly rim of minute air-bubbles clinging round its bottom angle. Into the cell we now place our Blow-fly's head or other object, and with a needle or small sable-brush arrange it in the centre in any desired position. Insects mount best by placing them on their backs.

After seeing that the cell is brimful with fluid, we take up a clean cover-glass of such a size that it is not quite so wide as the full width of the vulcanite ring, and on the under side of this we breathe gently: then quickly place one edge downwards on to the vulcanite ring, in the position it will finally occupy, and somewhat slowly lower down the opposite edge on to the ring till the cover-glass lies flat. If this is properly done, there will be no air-bubbles in the cell, nor any clinging to the cover-glass; neither will the object be forced from its central position. To ensure the still tacky cement fastening the cover-glass securely, we place over the whole a slight spring-clip, and leave the mount thus for some hours. Then the clip may be taken off, and the slide washed under the tap; when dry, a new ring of cement should be placed on the edge of the cover-glass and on the outer edge of the vulcanite ring: to which any rings of coloured cement may afterwards be added. There are few finishing cements that are equal in appearance, or so durable, as that made by adding one-third of gold-size to some Brunswick Black: it dries rapidly and is tough and elastic.

For mounting in Canada Balsam or Dammar, we make a similar ring of brown cement on the vulcanite ring. Inside the ring, or cell, we place a drop or two of turpentine, which we then shake out again, and fill up the cell with the fluid balsam. Into this we place the object, taking it from the turpentine in which it had been left to soak, and arranging it in the cell. On the under-surface of a clean cover-glass we place another drop of turpentine, allow it to run off, and then lower down the cover-glass just as in the former case. After the spring-clip has been on for a day or two, we can carefully scrape off the excess of balsam, wiping the top carefully with a rag moistened in spirit, and then running a ring of cement round the edge as before.

And now we have mounted, let us say, two heads of the Blow-fly,—one in glycerine fluid, the other in Canada Balsam. Let us see how they look through the microscope. Our first impression is—how different the object appears to that spread-eagle thing we have so often looked at! Why, we can actually focus down and

see, first, the tips of the hairs on the top of the fly's head; then we see their insertion on the scalp; and focussing somewhat lower we enter the cavity where once part of the brains were,—only a cavity now, through which meander a pair of tracheal tubes, but where once our blow-fly did all her thinking,—where she laid her plans for stealing our sugar, and for the safe depositing of those minute progeny so dear to the cultivators of the *gentle* angling craft. Lower down still we come to the roots of the hairs at the base of the skull. We really must have revolved our fine adjustment-wheel some dozen times, and we remember how formerly, with only half a turn, we used to find ourselves at the other side of our flattened specimen.

On each side of the globular head stand out the many-facetted eyes. At the base of the proboscis which juts out from the front are the strange pair of antennæ. In the middle of the proboscis stand out the palpi. In a groove near its end lie the sharp setæ or lancets. The end is swelled out by a beautiful network of pseudo-tracheæ into two semi-heart-shaped masses, between which we discern the salivary tube. And now it is easy to understand how the sugar disappears. There, under our binocular, the "Tongue of a Blow-fly" stands out solid, and looks as we never saw it before; it is more than ever a thing of beauty, but its *use* also is plain. Turning over the slide, we notice underneath the narrow opening from which some tracheæ still project, and through which there once passed nerves, muscles, digestive canal, and tracheæ, from the head to the body.

Let us henceforth resolve that we will no longer crush out of their real semblance any more of Nature's beauties, no longer fill our minds with false notions of the truth; but preserve, so far as we can, the true and lovely form that Nature everywhere bestows upon her creatures!

Aquaria for Microscopic Life.*

IN the management of small Aquaria a very little experience is of great value. The first attempts are usually not successful, but after a while it will be found that the aquaria run along without much trouble. The secret of this is in the experience, which seems to have come very naturally, that indicates to us just

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about how much plant-life there should be in a given quantity of water, and where the aquarium should be placed to ensure the most satisfactory growth.

It need not be said that the conditions of prolific growth in an aquarium are the same as are found in open ponds; but to imitate those conditions indoors requires some judgment. The collector will observe that the water in ponds, although freely exposed to the glare of the sun, never becomes greatly heated, because of the rapid evaporation from the surface. But if an ordinary aquarium be thus exposed to the sun, the small body of water would soon become so warm that many organisms would die in it. Therefore, the aquarium should not be placed in sunlight. By far the best place is near a window where it can receive good light from the sky all day long, but no direct sunlight. The first, and most important rule is, to keep the water cool.

For microscopic specimens, a small bottle, holding about 6 ounces, with square sides, makes an excellent aquarium. Such bottles should be about two-thirds filled with water, and covered to exclude dust. We have used the tin-foil that tobacco is wrapped in to cover them, and found it well adapted to the purpose. Several of these bottles should be kept with sprigs of water-plants growing in them, so that whenever an interesting specimen is found it can be put into one of them, to grow and multiply by itself. In this way, it is sometimes possible to cultivate microscopic forms of life very successfully. We have thus grown hundreds of the common rotifers, and kept them for weeks in the winter-time. That was done, however, in a one-ounce bottle, which had a small bit of *Nitella* in it. We have also kept *Volvox* in fine condition for many days in a small bottle covered with a watch-glass.

Beginners in this work are apt to put too much material into their jars. A very small bit of a vigorously-growing plant will suffice, and if too much is introduced, it will soon lose its vigour, and some of it will decay and make the water impure.

The jars should not be disturbed much, and when they are moved they should be handled carefully, and then replaced as they were before, in order to ensure uniform conditions of light and temperature.

We have seldom been troubled with an excessive growth of unicellular algæ on the sides of our jars. Usually these come from an excess of light. But a filamentous *Cladophora* found its way into one of our larger jars more than a year ago, and it became such a nuisance that finally the jar was given over to that plant entirely, and is now green with it. When the jar is wanted for other use, it must be washed in boiling water to get rid of the too-prolific alga. When minute algæ do come in such abundance as

to be troublesome, set the jar in a dark closet for a few days and they will disappear.

However, for microscopic purposes, such growths are not usually objectionable, for some of the Infusoria delight in them, and it is not necessary to keep the sides of the small bottles clear, as in the case of larger aquaria. Nevertheless, they should not be allowed to increase too much, for if they do they may suddenly fill the water with a cloud of swarmspores, and bring about a decomposition which will kill everything therein. Such a condition of affairs, if threatened, can be prevented by removing the jar a short distance from the window, when growth will be less rapid.

It does not seem to be a matter of much consequence what plants are used in the microscopist's aquaria. *Nitella* is a clean and hardy plant, and we have usually preferred it. One or two stems, a couple of inches long, is enough. *Anacharis* is also excellent for the purpose; *Myriophyllum* would doubtless prove quite as good, and perhaps even better, for it is a plant with leaves well adapted as a resting-place for the tube-bearing rotifers. Besides these we have *Ceratophyllum*, *Callitriche*, *Utricularia*, *Naias*, and *Potamogeton;* but some persons prefer *Ceratophyllum* above all other plants for the aquarium.

As for the stocking of small aquaria, the only precautions are, not to put in too much material, and not to put in animalcules that will kill each other. Our plan is as follows:—When we have a collection of pond-life, plants, and animals of all kinds all together, we put the whole mass into a saucer of water and let it remain there until it is convenient to look it over. In a saucer the collection will keep fresh, while in a bottle it would soon become foul. Then, in looking over it with the microscope, the animalcules that it is desired to keep are transferred to the bottles, either by washing them off from the slide upon which they are found, or, if practicable, by the use of a dipping-tube. But a mass of algæ or of *debris* that is supposed to contain infusoria of interest is not introduced at random. Such a mass may be dropped in for a few hours and then removed by forceps or dipping-tube; but it must not remain long enough to decompose. This should never be done in a bottle that already has a variety of living forms in healthy growth, as thereby there is danger of losing them by introducing incompatible creatures.

Sometimes it is desirable to keep a certain specimen found in a jar attached to something, as a leaf or stem, separate from the others for a short time. This can readily be done by placing it in a small tube, uncorked, which can be suspended in the jar by means of a thread, or by a bit of sheet-cork with a hole cut through it. In the same way a number of specimens can be

selected and placed in tubes, which can then be suspended in a jar of water and carried about—to a meeting of a Society for example,—in this way securing the advantages of a considerable quantity of water, while the specimens are easily found.

The secret of success lies in having the plants in the small jars growing well before the Infusoria are introduced. Even then many of them will not live, for they are very sensitive creatures and will not well bear sudden changes in their conditions of life. But perseverance and experience will bring their reward in this as in other things.

The microscopist who desires an inexhaustible source of entertainment, or a rich field for investigation during the winter evenings, can provide for these in no better way than by starting a number of aquaria now. September is the proper time to start aquaria for the winter, and we trust many of our readers will act upon the suggestions of this article, for if they do so we are sure to hear of many observations they will make.

Besides the numerous small aquaria, the microscopist would do well to have one or two large tanks, holding about two gallons, in which can be kept a stock of plants and animals of different kinds; and one tall jar in which *Vallisneria* can be grown. In the large tanks should be kept different water-plants, such as *Nitella*, *Anacharis*, *Myriophyllum*, *Lemna* (duck-weed), and others, from which the small aquaria can be replenished. In these may also be kept many microscopic specimens from collections, and especially snails and *Daphnia*, *Cyclops* and other Entomostraca. The snails may be occasionally introduced into the small jars as scavengers, and the Entomostraca can be used to feed the *Hydras*, which will probably be found in one or more of the jars.

The cyclosis in plant-cells is very beautifully shown in *Vallisneria*, and this plant can be grown in a tall jar without any care whatever. The roots should be imbedded in mud and sand at the bottom. The plant will grow rapidly, and probably fruit in the jar. It will die down in the fall, but in the spring it will again grow if the roots are undisturbed.

How to Prepare Foraminifera.

SECOND PAPER.

THE experience gained by washing shore-sand, and floating off the Foraminifera, as described in a preceding Paper, will prepare for the manipulations about to be described.

Next to having the "material," a good supply of clean, *fresh* water is essential. If water is "laid on," it will be found a great convenience to have a piece of india-rubber tubing about a foot long, to fit on the end of the water-cock, so as to be able to move the jet of water to any part of the sieve, when washing the material. By squeezing the end of this tube with the fingers, the force of the jet may be increased, and a very fine stream may be easily produced for washing the cleaned material to one side of the sieve, just before tipping it on to the plate; or a perforated cork may be fitted in, so as to insert a glass tube, drawn to a fine point, which will give a jet with more convenience than a washing-bottle.

As to apparatus needed:—The sieve, before mentioned, (or some modification of it,) being necessary, I will describe mine. It is a strong zinc cylinder, open at each end, nine inches in diameter and four inches deep, having a one-eighth-inch *brass* wire round the mouth, and a similar, but *finer* wire round the bottom end. Over *this* end is tightly tied with fine *dry* pack-thread, a *dry* piece of millers' silk-gauze, 180 threads to the inch, which is pulled as tight as possible, and well wetted with clean water every time before using. By using this gauze we can easily and thoroughly clean the sieve, by removing and well washing both gauze and cylinder, and thus run no risk of mixing the species in "gatherings" from different localities,—a point of essential importance in any scientific investigation. The gauze should be cut with a good margin, so that it may readily be replaced on the cylinder, and being very durable, is no worse for being hemmed. By removing the gauze, and tying a fine linen handkerchief loose *over the top*, the cylinder will make a good bag or basin, which is sometimes very desirable. I will call this sieve "number one."* Tin-plate

* A very full description of the Sieve arrangement used on the "Porcupine," etc., is given in "The Depths of the Sea," by C. Wyville Thomson, pp. 259—261. The whole chapter will repay careful reading.

and iron wire should not be used, as they are sure to rust, and rot the gauze.

For filtration, a similar cylinder, three inches in diameter and three deep, with a thick wire or flange at the top, (made so that it may rest on the ring of a retort stand), and a fine brass wire at the bottom, will be found very useful. This is used by tying over the bottom a sheet of good filter-paper, free from holes, and outside it a piece of gauze or muslin to prevent the paper bursting through. For very small quantities, broken test tubes may be used in the same way. The funnel-filter, as I know to my cost, is not satisfactory, being apt to burst, and its valuable contents to be thereby lost. There are small glass cylinders to be had at the apparatus shops, which answer well.

If the preservation of the Polycystina, or larger Diatoms, in any gathering is desired, the *finest linen* handkerchief should be used for a bowl, as described; but for all other purposes, the 180 gauze is everything that can be desired. I have sometimes used it double, crossing the threads diagonally. This gauze may be obtained at most of the wire-workers who supply mills; it is made in Lyons.*

The material from which fossil Foraminifera may be most easily prepared, is, perhaps, chalk-powder. Many ways are recommended for doing this, one text-book copying another,—apparently without proving the process, but just hoping it may be a success. One plan which I remember advised to get a piece of chalk and to brush it gently in water; allow this to stand and settle, then pour off the water and add fresh, and repeat as needed. Finish by spreading the sediment on a slip to dry, and add Canada balsam. Another recommended to get the fine powder found at the base of a cliff by the weathering of its surface, and treat this similarly with water. I have spent hours working each of these, and other plans, with chalk from Dover, Gravesend, and elsewhere, in which Foraminifera are known to abound, and never got any satisfactory result; so I gave up trying to obtain the Foraminifera as hopeless. Since then, through the kindness of my friend, Joseph Wright of Belfast, I have learnt how to go to work with success.

The proper material,—the *only* material worth handling,—from which to obtain the Foraminifera found in the chalk in a condition, almost, if not quite, uninjured, is the powdery matter found in the cavities of the flints which abound in the chalk, but especially in

* Of course, where the Siliceous organisms *only* are wished for, the best way is to treat at once with acid so as to dissolve everything else, after which, wash as for Diatoms.

cavities in the large nodules known as "Paramoudras,"* of which a sketch is here annexed. Paramoudras are masses of flint of a very irregular ovoid form, (as irregular for size and shape as potatoes,) in which are cavities of various sizes, filled with chalk, which not unfrequently is in the condition of powder; like flour if dry, or like grey clay, if wet. This powder contains Foraminifera, Ostracoda, Sponge-spicules, bits of corals, shells, etc., which, as a rule, are in fine preservation. Properly speaking, the siliceous "casts" of the Foraminifera are what are generally found, the "cast" being an exact reproduction in silica, or glauconite, of the body as well as the shell of the animal,

coated over with a delicate film of lime of purest whiteness,—probably all that remains of the shell of the little creature it represents,—and marked with all the exquisite traceries which it bore. What can we think of the plan recently recommended for cleaning and separating these organisms from the sand, etc., among which they occur, by shaking up the chalk-powder with water in a bottle, the "gentle friction" of the particles one against the other being nearly the most certain way of removing this film, and thus utterly spoiling the specimens for either investigation or preservation in the cabinet! I have tried it, and would warn anyone else from doing so; the plan is worse than useless.

Having got some *proper* chalk-powder, if it is dry, the first thing is to sift it through a rather coarse sieve,—zinc, perforated, with holes one-sixteenth of an inch in diameter will do,—so as to remove all the fine flakes of flint, which would cut the gauze like lancets. If damp or wet, the powder may be *washed through* this zinc sieve (under the tap) into the large sieve "number one." Either way will answer well, but after much experimenting, I prefer first to dry perfectly, and sift dry. What will not pass

* "PARAMOUDRAS.—Several of our flints assume curious and peculiar forms. They are known as *Paramoudras* from the following circumstance:—The late Dr. Buckland, in one of his geological rambles in Antrim, seeing these flints for the first time, was surprised at their curious form, and asked his guide what their name was. The guide, who had previously been puzzled by the hard names the doctor gave his geological specimens, determined to coin a puzzler himself, and replied that the flints were called *Paramoudras;* and thus they were named by the Dean of Westminster. (See Trans. Geo. Soc., London, Vol. iv.)

The *Paramoudras* are somewhat cylindrical in form, from one to two feet long, and from ten to sixteen inches in diameter. They usually have a hollow in the centre, which sometimes passes through from end to end. In the quarry, the *Paramoudras* stand on end; and two, three, and even four have been found in the chalk, one over the other, like a jointed column."

(From "Belfast Naturalists' Guide to Belfast.")

through this zinc sieve must be well and carefully washed, and looked over when dry, as it will contain the largest forms, some of which, as *Nodosaria*, *Dentalina*, etc., may be nearly half-an-inch long.

A large cup-full of the fine sifted powder must now be put into sieve "number one," and a good stream of clear fresh water be allowed to wash it until all signs of milkiness have disappeared, and the water runs away quite clear. Do not use either fingers or spoon to stir up the material, but let the stream of water from the india-rubber tube do all the work, directing it so as to move the powder well about. When the water runs away clear, wash all into a corner of the sieve, drain, and tip out the chalk powder on to a plate to dry *thoroughly* in the oven. Repeat this process until all is washed; and when dry, and cold, sift into sizes for examination. The finest siftings will probably be the richest in species.

If the chalk-powder is good and the washing properly done, a considerable portion will be found to consist of Foraminifera, Ostracoda, Sponge and other spicules, etc., the remainder being sand, etc.

If sponge spicules or other siliceous organisms only are being sought for, pour dilute Hydrochloric Acid over the Chalk-powder, and let it remain for a day or two to remove all the lime; after which pour off the acid, and wash well with clean water until every trace of the acid is removed; then dry, sift, and examine.

As these Foraminifera are fossil, and mostly siliceous, they will not "float," but the washed material (after drying) must be examined under the microscope, and the individual shells picked out. There is no royal road for doing this. It is best done by means of a fine miniature red sable pencil, wet with clean water, and just passed through the lips so as to bring it to a fine point, and prevent its being too wet. A full description of the *modus operandi*, either for fossil or recent Foraminifera, is given near the end of the present article.

Fresh dredgings of sea-mud, shore-mud, etc., may be treated thus:—

If principally sand, the process described in the first paper (page 26) must be followed throughout.

If soft mud, a small quantity should be put into a suitable vessel (say a large wide-mouthed jug), full of fresh water, and be well stirred up to about the consistency of cream. Sieve "number one" being ready, and well wetted, should then have a little of this cream poured into it, and upon this a good stream of fresh water should be allowed to run so as to wash the mud, until the water runs away clear; after which the contents of the sieve may

be tipped upon a plate, as before described, for drying. Do not use a spoon for emptying the sieve. Repeat this operation with all the material, after which the process given in the first paper must be followed throughout.

Should the material be dry, or in hard lumps, as the Lias Clay, etc., first soak it in water in a jug, until it has fallen down like mud; after which proceed as has just been described for fresh mud. Use the water freely.

It must be observed that the Foraminifera in the Lias and many other clays, being true fossils, will not float, but must be searched for in the washed material after drying. Such clays as are found on raised beaches, or estuaries, being sub-fossil, generally contain the Foraminifera in nearly the same condition as if recent, and such will float, if not too large.

Too much care cannot be taken with the first washing, so as to secure the removal of *all* the fine mud, which, if not thoroughly removed, will cause almost endless trouble afterwards, sticking the shells together and to the sand-grains, and so preventing them from floating, also coating them with minute specks of dirt, which spoil their beauty and hide the (often characteristic) markings on the shells.

Be careful not to put too much mud in the sieve at once, or it will be clogged, and be very difficult to work, especially if a handkerchief is used instead of the gauze. Not unfrequently,—and I have not yet satisfactorily seen *why*,—some difficulty is experienced at first, the muddy water seeming as if it would *not* pass through the handkerchief; and then in a minute or two it will run off pretty rapidly. To assist this, it is desirable to keep the mud well stirred up by the stream of water, which is far better than using the fingers or a spoon for the purpose, as it runs less risk of crushing the minute shells.

Where the Foraminifera are mixed with tallow, lard, etc., as is frequently the case in ship's soundings, they should first have boiling water poured over them, in a beaker-glass, so that the tallow may melt and float. Allow all to get cold, and when the tallow is set, remove it; examining it to see whether any Foraminifera are adherent, in which case they may be removed with as little tallow as possible, and re-melted in a second beaker. Then, when cold, drain off the water and boil the soundings in *liquor potassæ*, B.P., so as to convert all traces of grease remaining into soap, after which wash well with clean water, and finish with boiling water. When dry, the soundings may either be examined as they are, or floated, if in any quantity. I have found this plan very successful, and it gives but little trouble. Various plans for dealing with soundings may be seen in Davies's work on Mounting.

* * * * * * *

This Paper would be incomplete without a few practical hints as to how to examine the floatings, etc., for the Foraminifera.

The microscope must be used all but, if not quite, upright,—the latter is best, though rather awkward. If furnished with rectangular motions, such may now render good service; but these are far from being essential, and, in fact, a simple arrangement of a sliding stage and tray, which may be made by the student, will answer every purpose and do first-rate work.

A tray of some sort is necessary, and may be easily made of a piece of *thin* slate, say 4 inches by $2\frac{1}{2}$ inches, rubbed down perfectly flat on each side; but I much prefer a tray made of *black* ferrotype-plate, 4 inches by $1\frac{1}{2}$ inches, with the edges on each side, and one of the ends turned up neatly about $^1/_{16}$th of an inch. On this tray must be spread *as thinly as possible*, by gently shaking from a pill-box or spoon, a layer of the "floatings" or other washed material, for examination. The tray must then be passed regularly to and fro across the stage of the microscope, in such a manner as to ensure the examination of the whole of the surface, without needlessly going over any part twice. This may be easily done by commencing at the side furthest from us, and moving the slide *from the right to the left*. Then move the slide *away* a distance equal to the width of the field of view, and returning it again to the right, examine a second time while passing *from right to left*. It is better to have a definite plan as here given, and not to work left to right and right to left, but only *one* way, and I believe pushing the tray *from* the right *to* the left will be found most convenient. The shells should be picked out with the sable pencil, as before described. The lower the power of the objective the better, and it is rarely needful to go higher than one inch.

Of all ways of mounting Foraminifera, none is to be compared with mounting them as opaques. When mounted in balsam, as transparencies, it is almost, if not quite, impossible to identify the different species. Foraminifera look best without a covering-glass; hence, a cell which admits of the cover being removed without injury is to be preferred. These may readily be made by selecting ebonite rings of such sizes as that one will fit just inside the other; the smaller one should be well cemented to the glass slip, and the cover be fixed on the larger one. Ward's "Brown Cement" is first-rate for the purpose, but old Gold-size will do. Cells made of thick cardboard with a hole punched through one piece, which is then pasted to a second, with a piece of black paper under the hole, are very useful and easily made, and are largely used. Section-making scarcely belongs to the purpose of

the present paper, but may perhaps claim notice in a future number.

The operation called "floating," which has been described in these papers, was first made known by Professor Williamson, in his Monograph on British Foraminifera (Ray Society), which contains excellent figures and descriptions of most of our species, and is still the text-book.

For students, Dr. Carpenter's "Introduction to the Foraminifera" (Ray Society), also his papers in the Philosophical Transactions; a paper by Parker and Jones in Philosophical Transactions, on the Foraminifera of the North Atlantic; and various papers in Annals of Natural History Magazine, by Dr. H. J. Carter and others, will all be found full of valuable and interesting information.

CHARLES ELCOCK.

Belfast.

An Hour at the Microscope,

With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

PLATES 13, 14, and 15.

Funaria hygrometrica.—The peristome of this Moss furnishes an exquisite object for the microscope.

In mounting, it is desirable to show one peristome, at least, looked directly down upon, and one in exact profile; while another in section, to show the columella, would add much to the value of such a slide. The one lateral *seta* developed on the inner side, and near the point of each tooth of the peristome, is highly interesting; as is also the delicately reticulate, cancellous membrane in the centre of each mouth. The section suggested would also show the set of sixteen inner peristomial teeth, on which one of the characters of the genus is based.

Petal of Geranium.—The structure is one which is not uncommon in petals,—an elevation of the centre of the cuticular cells (mostly of the upper—*i.e.*, *inner* series) into papillæ, the delicate furrows on which are often exceedingly elegant. When these papillæ have still further developed, they then form hairs. The Periwinkle, Primrose or Polyanthus, Garden Balsam, Snap-

dragon, Borage, or Comfrey, may all be instanced as good examples of this structure, readily accessible and not generally known. A short paper on the subject was contributed by the writer to the Microscopical Society of London, and will be found in their "Transactions." There is much yet to be learned respecting them, if any member of "Ours" will take it up in earnest. The principal points to be noted will be found under the head of "Spiral Structure," "Secondary Deposits," and "Pitted Structure," in the "Micrographic Dictionary."

Cotton Seed.—Portions, and even entire seeds, may not unfrequently be found amongst the common Sheet Cotton-Wool; and with these should be examined, for the sake of comparison, seeds of all the Mallow order which can be obtained:—five species grow wild in this country. Then there is the *Althæa*, with the various species of *Malope*, *Hibiscus*, etc., the names of which can easily be obtained from any seed-catalogue, and good specimens purchased.

Recent Polycystina.—I wish there were indeed a "Royal Road to Learning," as those members who think that all which a slide can teach may be learnt at a glance, or in a few minutes at best, seem to suppose. To grasp all the knowledge which a good slide of these organisms is capable of imparting would take a couple of days' steady work. Major S. R. J. Owen's observations "On the Surface Fauna of Mid-Ocean" (Proceedings of Linnean Society's Journal, Vol. VIII., 1865, p. 202; and Vol. IX., 1867, p. 147) should be specially consulted by any who would go into the subject. They appear to render it certain that the Polycystina live *on the surface* of the ocean, appearing mostly at night; that in some tracts they are exceedingly abundant, in others scanty or none at all. Facts of a most interesting kind, relating to self-division, conjugation, and other points in their life-history, so far as known, will be found detailed.

Teeth from the Sucker of Cuttle-Fish.—I can find none but most imperfect accounts of these peculiar rings of Sucker-Teeth, and am unable to refer to any *figure* whatever of them:—more information respecting them would, therefore, form a very acceptable contribution to our knowledge. Where spoken of they are described as "horny," but I do not know how to reconcile this statement with the condition these teeth present on a slide I am looking at, where nearly all are broken. And what is still more remarkable, the fractures are transverse! From mere reasoning on the matter, it seems to me we should expect the fibres would be best fitted to resist strain if they ran longitudinally, and not across the direction in which a straining force would act. I think, too,

there must be a considerable amount of earthy impregnation, or they would not be so brittle. How far, however, the treatment with Caustic Potash they have probably undergone is answerable for their present condition, I cannot say. Caustic Potash is a dangerous ally, of which members will do well to be as careful as they would of fire; simple maceration, and then mounting as an opaque object in a cell sufficiently deep to prevent all chance of crushing, would be the best way to learn the true structure and condition of these parts.

Spines of Solaster Papposa (Pl. 13, upper half).—The jointing of the bony framework is very interesting; and I wish particularly to call the attention of those who are fortunate enough to reside at the seaside, or who possess, or have access to, Marine Aquaria, to the rounded openings in the integuments. They appear to be too numerous and too regular to be accidental. What is their purpose? Are they contractile? Have they anything to do with a circulation of the water to the body cavity? Are they found in others of the *Echinodermata*, and if so under what modifications? The spines are arranged in bundles on short stalks; the number in different bundles varies considerably, and judging from their arrangement as seen here, they must have a power of independent motion—possibly like the vibracula in Polyzoa—for sweeping the surface of the animal clear of extraneous particles. It will be interesting to compare the spines of other species of *Echinodermata* with those now under discussion, which appear to be really compound spines, and sessile.

Flustra foliacea (Pl. 14) is a capital illustration of a typical Polyzoon. Sometimes the marginal spines are quite absent; at other times (as in a specimen now before me, gathered on the coast at Boulogne), they are exceedingly numerous, there being an additional one at either side, and one projecting like a horn from the convex end of each cell. Such a condition is probably owing to luxuriant growth under favourable circumstances. The horse-shoe-like plate at the opening of the mouth serves the purpose of a little door, opening and shutting at will. An ovicell is represented in Figs. 1 and 3; specimens are occasionally found thickly covered with these curious egg-capsules, of which an interesting description has been given by the Rev. Thomas Hincks in the "Popular Science Review." I have seen, after storms, pieces of this Flustra thrown up with the tenants of these elegant little "berceaunettes" in full vigour of life, and expanding beautifully when put into a basin of sea-water. It is well worth while to try and give permanence to such a display. This has been successfully accomplished in many cases by dropping gin

carefully into the vessel containing them; and the spirit flying to their heads, poor things, they forget to withdraw their beautiful plumes.

Probably, Glycerine and Water (increasing the proportion of the former as the latter evaporates) would be the best way to mount them. Goadby's fluid, a solution of Bay-salt, is apt to leak out, and weak spirit is a very treacherous material.

On making sections through the Polypidom, numerous openings are seen in the horny walls, whereby circulation, nutrition, and consentaneous action are secured, through the medium of delicate nervous threads.

[Whiskey, pure Alcohol, Carbolic Acid, and other like things, have all been recommended, and tried with more or less success, for the purpose of instantaneously killing the Polyzoa with their tentacles exserted. We have not tested it personally, but very probably the process with Picro-Sulphuric Acid, used by Professor Entz, and described in Part II. of this "Journal," will be found as effective as any. Only care must be taken, in applying it to such species as have calcareous Polypidoms, to eliminate the acid as soon as possible.—*Editor.*]

Hæmatopinus suis (Hog-Louse), (Pl. 15, lower half).—The points specially to be attended to in observing these creatures are:—The rostrum, which is highly curious; the stiff bristles (whiskers) on either side of the mouth; the tactile papillæ (having probably gustatory functions), which terminate the antennæ; the eyes seated on stout projections immediately behind the last-named organs; the large metathoracic spiracles; the singular and not unpleasing design on the dorsal surface of the abdomen, which may be compared with that of the same part in the Pigeon-Tick, *Argas reflexus*; the six pairs of abdominal spiracles, of which the first pair differ much n outline from the others; the male organs of generation; the powerful limbs, and varied structure of the parts composing them. *Hæmatopinus suis* is a capital type of the genus Hæmatopinus, and of the suctorial division of the Anoplura.

[This louse is identical with a human parasite prevalent on beggars—one of three kinds which honour humanity with their company.—A. Nicholson.]

[Denny gives the following additional particulars which may prove interesting:—"This species is found in great numbers on swine, but it does not appear so generally spread as might be expected from the dirty habits of the animals. It most frequently occurs on those freshly imported from the Sister Isle.

"In walking, this species uses the claw and tibial tooth with great facility (which act as a finger and thumb) in taking hold of a single hair. The male is much smaller than the female, with the abdomen shorter, sub-orbicular, and the segments lobate; the egg is three-quarters of a line in length, of a creamy colour, and slightly shagreened, oblong and slightly acuminated, surmounted by a lid, which, when the young insect is ready to emerge, splits circularly, or, as a botanist would say, has a circumcissile dehiscence."—*Editor.*]

Lice (said to be) taken from a Gull.—I have had a slide sent to me, named as above, and I find that the objects do not belong to the Mandibulata as stated. I compare the mouth with the same part in the louse from Partridge, Gull, Vulture, or Turkey; and then with the suctorial mouth of *Hæmatopinus*, *Pediculus*, or *Phthirius*. I ask the little creatures what they have got in their maw. Oh! blood! As surely do they tell the work they've been engaged in, as did the blood on Lady Macbeth's hands. But where are the oval, nucleated corpuscles? The blood is not that of a bird, but of a mammal, and of a small one, too. No suctorial lice have ever been found on birds. These evidently belong to the genus *Hæmatopinus*, and seem to me to come nearest to the louse found on the field Campagnol.

The drawings on Plate 15, lower half, will serve to illustrate the details of the mouths of various species of lice.

[These last remarks are quoted to show the very shrewd way in which Mr. West was accustomed to detect any error in naming the slides that passed through his hands.—*Editor.*]

TUFFEN WEST.

EXPLANATION OF PLATE XIII.

UPPER HALF.

Portion of the arm of *Solaster Papposa*, showing the calcareous framework,—the membrane supported thereby, with openings in it,—and the bundles of spines, apparently seated on short stalks.

LOWER HALF.

These figures are specially intended to illustrate the characters of the mouth-organs in the mandibulate and suctorial Lice.

Fig. 1.—Mouth of Louse, *said* to have been taken from a gull.

,, 2.—Mouth of *Goniodes stylifer*:—*m.m.*, Mandibles; *mx. mx.*, Maxillæ; *lbr.*, Labrum; *lb.*, Labium.

Fig. 3.—Mandibles and labium (with its palpi) of *Lipeurus pelagicus* (Louse of Stormy Petrel) (after Denny) :—*lb.*, Labium ; *lbp.*, Labial palpus.

,, 4.—Mouth of Body Louse, human, *Pediculus vestmenti*, in different positions.

a, haustellum withdrawn.
b, partially protruded.
c, exhibiting the lateral horny hooks.
d, with the setiferous sheaths.
(Also after Denny.)

PLATE XIV.

Illustrating the structure of *Flustra foliacea.*

Fig. 1.—Portion of the Polypidom, as seen with a low power.

,, 2.—Sketch to show the animal protruding from one of the cells, with the ciliated tentacula, × 50 ; *r.m.*, Retractor muscle, for drawing it back into its cell.

,, 3.—Portion of the Polypidom, magnified 50 diam. *o.c.* in Figs. 1 and 3, represent Ovicells.

,, 4.—Vertical section, *transverse*, of the polypidom, showing the openings in the cell-wall, whereby vital connection is maintained between all parts of the structure.

,, 5.—Vertical section, *lengthwise*, indicating the same details ; *o.o.* in Figs. 4 and 5, openings.

PLATE XV.

LOWER HALF.

Fig. 1.—Hæmatopinus suis, ♂.
,, 2.—Anterior leg, more enlarged.
,, 3.—Antenna.
,, 4.—Haustellum.

Selected Notes from the Society's Note-Books.

INORGANIC.

Dendritic Spots on Paper.—Several short notices and an article on this subject will be found in "Science-Gossip," vols. 4 and 5. It appears that some authors have supposed these spots to be an Alga, others a Fungus. The former have named it *Con-*

ferva dendritica; the latter *Dematium olivaceum.* Dr. M. C. Cooke believes it to be inorganic, and that it is caused by a speck of Iron or Copper Pyrites in the paper.

I have found it in considerable abundance in certain samples of *Blueish*-white paper, and in a few cases, but much more sparingly, on Cream-laid paper. I further suspect that its growth is assisted by certain atmospheric conditions, such as dampness, etc. In certain favourable circumstances, it not only penetrates the sheet of paper in which the nucleus is found, but also insinuates itself into the next sheets both above and below it. I am inclined to think that this spot is only to be found on comparatively modern-made papers, having searched carefully but unsuccessfully through some old account-books that were used before the days of steel pens.

A. ALLEN.

I have noticed these spots only on the blueish-white paper, coloured with smalts, used for ledgers, etc. There can be little doubt that they are merely inorganic, and due to crystallization. The repetition of crystalline forms lying at similar angles to each other will produce a very close imitation of vegetable forms, as all may see on a frosted window-pane.

Dendritic marks are common on the surfaces of the laminæ of certain rocks—as the Lias and Magnesian Limestone—and are composed of oxide of manganese, or sulphide of lead.

H. FRANKLIN PARSONS.

On rubbing the paper with a piece of India-rubber so as *partly* to erase the Dendritic spot, it will be found to have spread.

F. W. MORRISS.

The above Notes were written three or four years ago; but within the last few weeks I saw at the printer's a quantity of cuttings of blue-white foolscap paper, on which I found a number of Dendritic Spots, some exceedingly minute, others very much larger than any I had ever before noticed. Although I made every enquiry, I was unable to learn the history of these cuttings, further than that they were the waste trimmings of a job lately executed. The paper was practically quite new, and I have every reason to believe that it had left the mills at a comparatively recent date, yet here were spots larger and more beautifully

defined than I had ever yet seen. This would lead to the inference that *time* was not so much necessary to their formation, but rather that their development depends mainly on the size of the metallic particles forming their nucleus.

A. ALLEN.

BOTANICAL.

Crystals in Leaflet of Lathyrus hirsutus.—Professor Gulliver points out that the leaves and other parts of most of the *Leguminosæ* contain crystals. In some plants they are more abundant than in others, but in few do they appear to be more plentiful than in this, one of the rarest of our British species. Crystals generally require the Polariscope to show them properly.

For some time, all plant-crystals were confused under the common name of RAPHIDES, but Professor Gulliver has now divided them into four principal classes:—

1st.—True *Raphides*, which are acicular or needle-shaped in form, and with a *rounded* shaft, vanishing at both ends to a point. Their general shape is so like a needle, that they have been named after that useful article, from the Greek ραφις, a needle. They occur loosely in bundles, each bundle often containing some hundreds, and commonly within a cell.

2nd.—*Long Crystal Prisms*, which have distinctly angular sides, and truncate or pointed ends; they are always *twice, or more*, as long as broad. Sometimes they are as long and thin as true Raphides, but may always be distinguished by their *angles*. They are found either singly, or two or three together—so consolidated that they never admit of motion on each other.

3rd.—*Short Prismatic Crystals*, of cuboid, lozenge-shaped, square, and other forms, more or less prismatic, innumerable, and contained in cells firmly impacted in the tissues; mostly in chains along the vascular bundles of the plant; they are not quite as long as broad.

4th.—*Sphæraphides.* These are globular, conglomerate masses of Crystals, with their projecting ends either sharp-pointed, or rounded. Those of the latter form are sometimes attached to the cell-wall by a pedicel, and resemble in form a blackberry. The Crystals are often granular, smoothish, or stellate on their surface, and are commonly dispersed throughout the leaves and some other parts of the plant.

Of these four classes, the third (Short Prismatic Crystals)

seems to be the most varied, and crystals belonging to it are to be found of almost every form. The crystals in the leaf of *Lathyrus hirsutus* and those in most of the Leguminosæ belong to this class. Any two or more of the four varieties may occur together in the same plant. The sizes and shapes are not constant, but may all be referred to one or other of these four classes.

W. H. BEEBY and W. H. HAMMOND.

Those *Sphæraphides* which are "attached to the cell-wall by a pedicel and resemble in form a blackberry," may be found in great abundance in the leaves of the India-rubber Plant, *Ficus elastica*. They are best shown *in situ* by cutting thin sections of the leaves, which may be mounted in any way that the preparer fancies. A "bunch of grapes" is perhaps a more correct simile for these than a "blackberry."

H. M. J. UNDERHILL.

Plant Crystals.—I should like to know whether the difference in form between the crystals found in different plants corresponds to a constant difference in the chemical composition of the crystalline matters, or is due to physiological differences only. Of course, the formation of one kind of crystalline matter in one plant, and of another in another, is in itself a result of different physiological action; but there must also be some further difference in the vital condition of the tissues, to cause the crystals to occupy such different positions in relation to the cells, as they do in the different classes. A mere difference in chemical constitution would hardly account for the crystals in one case occupying the interior of the cell, and in another being imbedded in the cell-wall. What is the chemical constitution of the crystals?

In the Chickweed leaf, the sinuous shape of the epidermal cells is very curious; they fit together like the pieces in a picture-puzzle. The epidermic cells on the mid-rib are of a different shape from those on the blade of the leaf. The spiral vessels are also well seen, and their mode of termination; or, rather, they have no end, but form anastomosing loops, which bend round, and so join on with the bundle in another nervure.

H. F. PARSONS.

ZOOLOGICAL.

Velia currens (Pl. 15, upper half) is an Hemipterous insect belonging to the family *Hydrometridæ*. In the last week of December I found a little swarm of about twenty or thirty strange, spider-like insects darting forward by leaps upon the surface of running water in a brook in this neighbourhood (Norwood), and after some trouble succeeded in capturing one. On comparing it with Westwood, and with Douglas and Scott's "Hemiptera-Heteroptera," I find it agrees sufficiently with their account to enable me to recognise it as *Velia currens;* but there are some points of difference in both descriptions which are worthy of notice. Like the allied genus, *Gerris*, it is found under two forms—a winged and an apterous condition: the one I found will be seen to be the latter. It differs from *Gerris* most markedly in the stouter and more oval form of the body, the comparative shortness of the legs, and their more equable distribution—the two posterior pairs of *Gerris* being placed close together, and at some distance from the anterior pair. Westwood says of the *Hydrometridæ*, that the antennæ are four-jointed, the terminal joints having occasionally a minute rudimental process at their base. This would make them five-jointed, and therein Westwood's statement agrees with that of Douglas and Scott, who describe the genus *Velia* as five-jointed; but if we include the rudimental joints in the enumeration, I find that both *Velia* and *Gerris* possess at least six joints, if not more,—as displayed in Figs. 2 and 6, Pl. 15; where it will be observed that not only the terminal joints, but the penultimate also, are furnished with this rudimental one, thus making six. There is also a ball-like joint at the base of the antennæ, but I am not quite sure whether this is properly to be reckoned amongst the components of the antennæ, or whether it is part of the face.

Again: Westwood says of the family that "the tarsi are short and two-jointed, occasionally, however, three-jointed, as in the fore-tarsi of *Velia*," from which one might fairly infer that the possession of three joints was confined to the fore-tarsi alone of this insect, instead of which I find that all the tarsi are three-jointed, as in Fig. 5; the basal joint being distinct although minute, like the before-named rudimental joints of the antennæ. The ungues in this insect are inserted in a cleft in the terminal joint, as in Fig. 4, beyond which they scarcely project. Douglas and Scott say that the apterous form is common in small companies on clear streams from March to September, but mine were found at the latter end of December.

A. Hammond.

EXPLANATION OF PLATE XV.

UPPER HALF.

Fig. 1.—*Velia currens.*
,, 2 and 6.—Antennæ of *Velia* and *Gerris.*
,, 3 and 5.—Tarsi of ditto.
,, 4.—Tarsus showing the ungues situated in a cleft of the terminal joint.

Daphnia.—When examining these rapidly-swimming little creatures in the living state, if you put them into a cell where they have room to swim about, it is impossible to get a view of them for many seconds together; while, on the other hand, if you put them on a flat slide, a very slight pressure applied to the covering-glass is sufficient to squeeze out their interior. The best way of seeing them is to place the drop of water containing them on a flat slip; drop on it a few loose fibres of cotton wool, and then put on the cover; they are thus held entangled in the fibres, as in the meshes of a net, and may be watched at leisure.

H. F. PARSONS.

The eggs in this genus are not carried in external sacs, as in *Cyclops*, but are lodged in the back, under the shell; in which receptacle the young are hatched, and are there retained until the moulting of the shell. The eggs produced in the autumn are snugly embedded in a thickened part of the carapace, called the ephippium; in which, after it has been cast off from the animal, they remain until they are hatched. By carefully focussing, the opening in the under-side of the shell, through which the legs are protruded when swimming, may be seen under the microscope.

R. A. HANKEY.

Thymus gland.—The Thymus is a body which fills a large portion of the anterior part of the thorax in young mammalian animals. After birth it dwindles away, and disappears by the time adult-life is reached. In the calf it is called the "Sweetbread; but the sweetbread of the pig is the *pancreas*, a very different organ. The Thymus is one of the ductless or blood-vascular glands; its use is not known, but is supposed to be to modify in some way the blood which passes through it, or the lymph. It has a capsule of connective tissue, which sends in

prolongations, or septa, dividing the gland into a number of lobules. Many lymph-vessels are contained in these septa. The substance of the lobules is made up of cells resembling lymph-cells, supported by a delicate network of trabeculæ.

H. F. PARSONS.

[It would appear from Kolliker's "Human Anatomy," p. 401, that the Thymus does not always cease growing immediately after birth, but continues to increase up to the second year of life. It then generally remains unaltered for some time longer, and the period at which it finally disappears seems to be somewhat uncertain. Kolliker himself has found it well nourished, and having just the same structure as in childhood, in individuals twenty years old; others say that atrophy commences between the eighth and twelfth years, whilst the period of its complete disappearance cannot be positively referred to any definite age, though it is not, as a rule, found after the fortieth year. Certain portions of it are gradually absorbed, while there goes on simultaneously a development of fat-cells and of connective tissue, and thus the glandular structure becomes in time entirely effaced.—*Editor.*]

Reviews.

THE POSTAL PHOTOGRAPHICAL SOCIETY.

THERE have been forwarded to us the Rules and Prospectus of this newly-formed Society, and we herewith subjoin a copy of the latter.—

"THE POSTAL PHOTOGRAPHICAL SOCIETY.—The above has been founded as a Postal Society for the convenience of amateurs in different parts of the country, and with the following objects—For the circulation of prints, negatives, etc.; for the exchange of photographs and of information on photographic matters, and for the general advancement of the Science and Art of Photography. It is to be noted that this Society will in no way interfere with any Society now in existence, but will rather tend to the advancement of existing Societies by bringing their members more into communication with each other. Entrance Fee, 2s. 6d.; Annual Subscription, 5s. Further information and a copy of the rules may be had on application to H. H. Cunningham, Hon. Sec., 7, Figtree Court, Temple. Committee:—G. Allison, Stoke-on-Trent; F. C. Cowley, Brighton; T. G. Horton, Royal Military Academy, Woolwich; J. Pocock, 21, Ladbroke Grove, London, W."

The Hon. Secretary will doubtless be pleased to supply any additional particulars on application. We wish the new venture every success.

BIBLIOTHECA MICROGRAPHICA.

A Bibliography of the Microscope and Micrographic Studies, being a catalogue of Books and Papers in the library of M. Julien Deby, F.R.M.S., etc. (D. Bogue, London).

The volume before us, which, though part 3 of the series, has been published before parts 1 and 2, is devoted to the literature of the *Diatomaceæ*. It was compiled with the co-operation of Mr. F. Kitton, F.R.M.S., and treats the whole subject of the *Diatomaceæ* in a thoroughly exhaustive manner, and will doubtless be found of great value as an aid in assisting the student to various works of reference on the subject.

MR. MARLOW, of Constitution Hill, Birmingham, has sent us a parcel of Ground-Edged Glass Slips, of various descriptions and of superior quality. For opaque mounts, there are plain opal, and coloured slips. Those who use sunk cells will find the clear, transparent cell in the opal slide to have a very pretty effect. Two very efficient and cheap zoophyte troughs, and an assortment of round and *square* tin rings of various thicknesses were also sent.

Correspondence.

The Editors do not hold themselves responsible for the opinions or statements of their Correspondents.

To the Editor of "The Journal of the Postal Microscopical Society."

SIR,—

I was very greatly interested by the paper in your second number, by Mr. A. Hammond, on "Stylaria paludosa," as I have, for some time, had a number of these interesting worms in one of my aquaria. Not being very "well up" in the recent literature on the subject, I was not aware that their multiplication by fission was doubted. I am pleased to say that I have been fortunate

M

enough to see this process take place on two or three occasions before, and once since, reading Mr. Hammond's paper.

Judging from my own observations, I cannot see how, if a little care was used, such differences of opinion could arise.

Let me take this opportunity of thanking the P.M.S. for the publication of a Journal, which I think is the best thing of the kind I have yet seen.

Yours, etc.,

Manchester. FRED. FARROW.

To the Editor of "The Journal of the Postal Microscopical Society."

SIR,—

A friend tells me he has met with *Bacillaria paradoxa* in the Canal, near Stoke, a few miles from this. Is not this unusual? Is not the genus supposed to be marine, or at any rate a brackish-water organism?

Stone, Staff. E. BOSTOCK.

WATER COLLECTING-APPARATUS.

To the Editor of "The Journal of the Postal Microscopical Society."

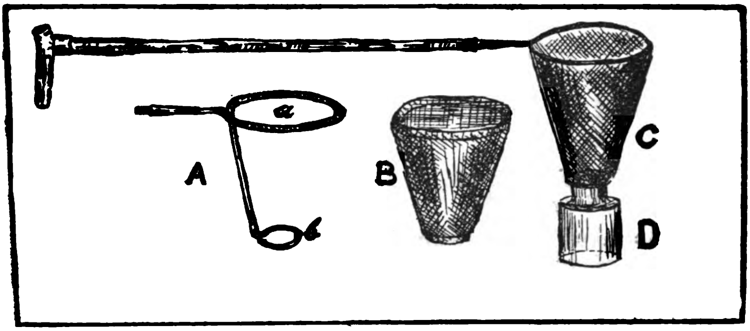
DEAR SIR,—

I should be glad for you to publish in your Journal, if you think it worth while, the following description of a piece of apparatus, which I have found very useful in fishing for microscopic objects in water. I have used it chiefly in searching for Hydrachnidæ, and so far have found no other piece of apparatus so efficient for that purpose; it can, moreover, be easily manufactured by anyone for his own use.

Obtain a piece of thick brass wire, and at about 6 inches from one end bend it into a ring 4 or 5 inches in diameter. After connecting with some finer wire the two extremities of the ring, bend the stout wire at right angles to the ring and continue it for about 4 inches. Then make another ring about $1\frac{1}{2}$ inches in diameter, and there terminate the wire,—leaving the smaller ring, however, not quite complete. The two rings will thus be parallel to each other. On the upper ring stitch a piece of tape, and to this sew a piece of muslin, made in the shape of a conical bag, and having its wider end affixed to the tape. Into the lower opening of this bag a small, wide-mouthed glass bottle, of about two ounces capacity, should be fastened by a piece of thread or fine string, and the lower ring is then sprung round the neck of

the bottle. The other end of the brass wire, which was left projecting for about 6 inches, is now to be firmly lashed to a light cane or stick, and your apparatus is complete.

Fig. 16.



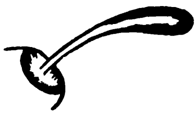
A Wire bent into shape.
a Ring to which muslin bag is sewn.
b Open ring to fix round neck of bottle.
B Muslin bag.
C Apparatus complete, with bottle D attached.

In order to use the apparatus, move it gently backwards and forwards on the surface of the water, under the surface, or just above the bottom of the pond, and among the weeds; the muslin will allow the water to pass through it, whilst any living organisms will be retained by the bottle. This can from time to time be examined with a pocket-lens, and when it is found to contain game, the lower ring of wire can be slipped off, and the neck of the bottle pushed up through the upper ring, thus inverting the net. The contents may thus be poured off into another bottle, and after re-arranging the apparatus, fishing may go on again. The object of the piece of wire connecting the two ends of the net is to keep all stiff, so that the bottle can be turned in any direction and yet both the upper and lower mouths of the net will remain open. A trial of this simple apparatus will, I think, satisfy all microscopic collectors of its great utility.

P.S.—The Oribate figured on Plate 10, Fig. 1, is not *Notaspis bipilis*, but, according to Michael, *Notaspis lucorum*, the *Zetes lucorum* of Koch. The *Notaspis bipilis* of Nicolet, or *Oppia cornuta* of Koch, is a very interesting and not uncommon beetle-mite, found generally singly, in moss. It is at once distinguished from *lucorum* by the hairs of the stigmata, which in *lucorum* are

short, curved, and flattened in a pyriform fashion, so as to appear as if knobbed; whilst in *bipilis*, they are long, straight, and spiky —*i.e.*, prickly.

Fig. 17.



Stigmatic Hair of
N. lucorum.

Fig. 18.

Stigmatic Hair of
N. bipilis.

The two mites differ greatly in other respects, but the peculiar character of the stigmatic hairs is sufficient to distinguish them.

Yours truly,

Kirton-in-Lindsey. C. F. GEORGE.

NOTICES TO CORRESPONDENTS.

All communications should be addressed to "Editor," care of Mr. A. Allen, 1, Cambridge Place, Bath. They must be accompanied by the name and address of the writers, but not necessarily for publication.

H. E.—We hope to insert your Paper in our next.

E. Bostock.—We remember finding *Bacillaria Paradoxa* some years ago on some Foreign timber floating in the Grand Surrey Docks, and we then thought that both had been imported together.

C. F. G.—We shall be pleased to insert your promised Paper.

J. E.—We are sorry to return your Paper, but think it unsuited for our pages.

Communications received from N.H., M. A. H., J. V., E. L., S. F., W. E. T.

SALE COLUMN.

Advertisements by members and subscribers are inserted here at the rate of SIXPENCE *for 20 words, and* THREEPENCE *for every additional 10 words or portion of 10.*

BOOKS RECEIVED.

Northern Microscopist, from commencement.

Quekett Journal, No. 1, New Series.

Natural History Journal and School Reporter, No. 51.

The Journal (Keighley), No. 3.

Recent Foraminifera

Errata.—On p. 91, *for* **Echinus** *read* **Echinocactus.** P. 35, last line of text, *for* "dorsal" *read* "dermal."

The Journal

OF THE

Postal Microscopical Society.

DECEMBER, 1882.

On the Structure and Economy of the Daphnia.

THE PRESIDENTIAL ADDRESS.

BY ARTHUR HAMMOND, ESQ., F.L.S.

Plates 18 and 19.

I PURPOSE to utilize the few moments which custom places at my disposal for the Presidential Address, by endeavouring to impart such information as lies in my power, on what may indeed be described as one of the commonest of common objects of the microscope.

The genus Daphnia, pre-eminently among the microscopic Entomostraca, is a favourite with every tyro in microscopical science. This arises, firstly, from its abundant distribution, seven species being found in our own country, some of them swarming in every piece of water whither microscopists are wont to resort; secondly, from its singular form; and thirdly, from the facility with which every portion of its organization can be made out, through the transparent cuticle in which it is enclosed. I trust, therefore, that the observations I shall make to-night may prove of general interest.

The articulate plan of structure common to all arthropods is

not easy to recognize in Daphnia. In no portion of the adult is the segmentation of the body so clearly visible as it is in a lobster or crayfish; and the great extension of the carapace—forming as it does a bivalve shell, enclosing the whole of the thoracic and abdominal regions,—obscures it if possible, still more, so that the number of somites, or divisions of the body, can only be ascertained inferentially, and chiefly by the appendages they bear. These are enumerated by Baird, in his history of the British Entomostraca, as follows:—The inferior or great antennæ, the superior antennæ, the mandibles, the maxillæ, and five pairs of feet.* I do not propose to enter into a full description of all these organs, but together with the labrum and the abdominal termination of the body, they will claim our first attention.

The great antennæ are the best known: they are the inferior antennæ of Baird. They are the sole organs of locomotion, thus offering a striking contrast to the sensory functions fulfilled by the corresponding limbs of the higher Crustacea. They are moved by three powerful muscles (*m m m*, Fig. 4), inserted in the integument of the head. In the two branches in which they terminate we may recognize the exopodite and endopodite of the limbs of the lobster or crayfish. The joints are furnished, as we all know, with beautiful plumose setæ. It is somewhat curious that these setæ are always wanting at the junction of the second and third joints of the posterior branch in the antennæ of *Daphnia rotunda*, a species common about London.

Just below the beak with which the head terminates, (which, by-the-way, must by no means be mistaken for a mouth,) we find the superior antennæ. These are inconspicuous organs in the female (see Fig. 11), but are much larger in the male and in the embryo young. They are usually terminated by a number of short, stiff setæ; and a large nervous ganglion in connexion with them at the base of the head, shows them to be sensory organs. Below the superior antennæ, and just covering the mouth, we find the fleshy upper lip or labrum (*lr*, Figs. 3, 4, and 11). We may have to look for this rather closely at first, as it lies within the anterior margin

* A fuller description of their form will be found in Baird.

of the valves, but occasionally it will be lifted by means of a long muscle (*m*, Fig. 11), inserted in its front wall, and arising from the back of the head, between the cœca or rudimentary liver, which will be hereafter described. A large nervous ganglion (*g′*, Fig. 11) occupies a considerable portion of its cavity, and blood corpuscles circulate freely within it. Probably it is the seat of the sense of taste. The labrum is much more conspicuous in the embryo young (Fig. 17) than in the adult.

The remaining limbs attached to the thoracic region of the body, together with the abdomen, are included within the valves of the carapace, and are more difficult of observation. An oscillating movement just below the anterior margin of the valves indicates the position of the mandibles (*m d*, Figs. 1, 3, 4, and 11). These are stout, bent pieces. If carefully traced, they will be seen to play on a pivot at the junction of the head with the carapace, and it will be noticed that their free extremities work against each other with a motion somewhat like that of the gizzard of the Pitcher Rotifer, but this can only be clearly seen when the observer is fortunate enough to get a front view of the animal between the valves. Below the mandibles are a pair of maxillæ described by Baird, but I have not succeeded in seeing them.

Following these are the five pairs of feet (1, 2, 3, 4, 5, Fig. 4); Baird has described them in detail as found in *Daphnia Schæfferi*, enumerating the several joints of which they are composed, together with the setæ, etc., appended to them; I must, however, content myself with general observations. The first pair of feet are modified in the male (Fig. 1). They are furnished with a claw and a long filament, which floats outside the shell, and supplies a very good sexual character. The males may at once be distinguished by this filament together with the greater size of the superior maxillæ (Fig. 1). In all these limbs it appears to me that two parts may be distinguished; an external pouch-like organ (Fig. 4) and an internal part curiously modified and furnished with plumose setæ and combs (Figs. 1, 2, and 19). Probably we have here again the exopodite and endopodite. The pouch-like organs can be easily seen through the valves of the carapace; they are furnished with a soft integument lined by

epidermis, and blood corpuscles may be observed to circulate within them. I believe they are the chief seat of the respiratory process, though perhaps this is also carried on within the walls of the carapace. The third and fourth limbs bear most beautifully formed combs,—the branchial plates of Baird,—but this I must regard as a misnomer. They are employed chiefly in collecting the food into the gutter between the bases of the limbs, which leads to the mouth. The abdomen is devoid of limbs, and it is difficult to say, consequently, of how many somites it is composed. It is bent upwards towards the head, and bears two or three fleshy processes on its dorsal surface, one of which (*p r*, Fig. 4) is instrumental in keeping the eggs and embryos in their places in the brood receptacle, and is terminated by two strong hooks in front of the anus.

The head of the Daphnia, though broad in the embryo, is often very narrow in the adult, where it encloses the eye, but it expands behind the bases of the antennæ into a sort of hood (*h*, Figs. 2 and 3), which serves to protect the delicate cuticle at the articulations.

The whole of the body and limbs of the animal, with the exception of the two pairs of antennæ, are enclosed in the hard cuticular covering of the head and carapace; the valves of the latter doubtless represent the branchio-stegites, or gill-coverings of the higher Crustacea, and I believe also the wings of Insects. Like these, they consist of a double wall (Figs. 7 and 8), and it is within this double wall that much of the circulation of the blood, which is so striking a feature in these creatures, goes on. It is well to bear this in mind, as the impression so apt to be conveyed at first sight, is that the stream of corpuscles carried round the posterior margin of the valves, circulates *between* them, an impression which a moment's reflection must show to be erroneous, as in that case it would be exterior to the body. Near the anterior margin of the valves there is a curious spiral marking (*s g*, Fig. 2), which Leydig calls the shell-gland, and likens it to the green gland or renal organ of the crabs and lobsters. He also says that the two walls of the valve are connected by trabeculæ, such as exist in the wing-cases of some beetles. Deposits of lime sometimes occur within the valves; these are of a somewhat stellate form (Fig. 10), and are affected by polarised light. A deposit of pigment is also found in individuals of advanced age. In *Daphnia Schæfferi* I have found the animal to be an opaque white from this cause. Sometimes, as I have found it in *D. psittacea*, the cavity of the valves is seen to be occupied with cells containing granules. These cells are generally spherical,

or slightly oval, except where mutual pressure distorts them; I believe this to be only another form of the white deposit of *D. Schæfferi.*

I was fortunate enough to witness on one or two occasions the moulting of these creatures. The cuticle splits in definite directions, one across the region of the heart, and another extending from the base of the great antennæ to the posterior margin of the valves (see *f f*, Fig. 2). In *Daphnia rotunda* I have observed that the line of fission passes between the reticulations of the valves, but never across them (see Fig. 25), and the fact that the reticulations in this part of the shell are so arranged as to leave straight lines between them in the line of fission, shows that the splitting of the cuticle is a matter not by any means of accident, but of careful prevision. In *Daphnia psittacea*, the line of fission is indicated by a row of minute spines. After the split had taken place across the heart, the head and antennæ were withdrawn, then the lateral split along the line of spines took place, and the valves being loosened, came off. The anal hooks and the covering of the feet were the last to come away; but these were thrown off slowly, and impeded the respiratory movements for some time. The exactness with which every detail of the process of moulting is carried out is well illustrated by the account of the mode in which the ephippium is cast, which has been furnished by Mr., now Sir John Lubbock, in the Philosophical Transactions of the Royal Society for 1857, part I., vol. 147; but to understand this, it is necessary again to bear in mind that the wall of the carapace is double, and that the new carapace is formed from the living epidermis within the cavity—*i.e.*, between the double wall of the old carapace, and that the ephippial eggs are lodged in a specialized portion of the brood receptacle *between* the valves.

The ephippium, as it is found after the moult (Figs. 2, 24, and 28), consists of an external bivalve case, enclosing another; within which last are found the eggs. The external case is formed from a portion of the outer wall of the old shell of the Daphnia, and the inner case from a corresponding portion of the inner wall, and the newly-formed *shell* is drawn out from between the two, without disturbing the relative positions of the differentiated portions, which make the outer and inner cases of the ephippium; so that after the moult the two cases are found one within the other, as they were before, although the new shell of the parent has been drawn out from between them. The ephippium thus cast off with the old cuticle, speedily becomes detached therefrom, the connection between them at the time of moulting being very fragile; in fact, only just sufficient to enable them to come away together.

The structure of the shell after moulting is frequently altered very considerably at the dorsal portion behind the line of fission, the lozenge-shaped, or polygonal reticulations, as the case may be, being here considerably smaller; indeed, where the ephippium has been cast, the reticulations disappear, and are replaced by irregular puckered markings (see Fig. 21). This is connected, I think, with the growth of the shell, which is more rapid on the dorsal than on the ventral margin, and is requisite to produce the brood-receptacle, for in the young this receptacle scarcely exists, the body occupying the whole cavity. In connexion with this, also, I may mention that Baird describes two varieties of *Daphnia pulex*, one having the spine in a line with the straight dorsal margin of the shell, and the other having it placed in a medial position at its extremity, the dorsal margin shewing as much, or nearly as much, flexure as the ventral. I believe this does not arise from varietal difference of form, but from excessive growth of the dorsal portion of the shell after the production of successive broods of young, for I do not find it in the young animals.

The mouth of the Daphnia is not easily discovered. It is situated immediately under the labrum or upper lip, and between the grinding surfaces of the mandibles (*mt*, Fig. 11). Hither are collected all the nutritious particles that come within reach of the current created by the movements of the feet. This current may be seen to set in between the anterior margins of the valves, as indicated by the arrow in Fig. 2, and the particles are collected in a sort of gutter, commencing with the posterior pair of feet, and extending thence forward between the bases of the limbs to the mouth, where they frequently form a dark mass (*f p*, Fig. 4). The alimentary canal commences with a narrow œsophagus (*æs.*, Fig. 11), which passes upward into the head between the crura of the brain; it is furnished with muscles (*m′*, Fig. 11) attached to the integument, which occasionally enlarge its diameter so as to allow a pellet of food to pass, and closes again immediately behind it. It corresponds to the fore-gut of the higher Crustacea. It then suddenly enlarges into a spacious cavity, which is continued nearly the whole length of the body, and forms the mid-gut. This cavity combines the functions of stomach and intestine, and is furnished with an outer muscular tunic of circular, and, probably, longitudinal fibres, within which is a glandular epithelium, and within this again a fine soft membranous lining; under ordinary circumstances indistinguishable from the epithelial coat with which it is closely connected. Sometimes, however, it is separated from the latter by a wide interval, and consequently becomes conspicuous (see Fig. 26, *m l*). I am inclined to think that this happens

previous to a moult, and that it is cast together with the external cuticle of which it is the homologue. The contents of the stomach, I have sometimes noticed, exude through it, as if it had lost its continuity in places; I have also seen a similar sloughing condition of the internal membrane of the stomach of the larva of the Crane Fly. The remaining portion of the alimentary canal consists of a short rectum, or hind-gut, of considerably less diameter than the stomach; it opens immediately below the large pair of anal hooks (see *r*, Fig. 4). A peristaltic movement is visible in the stomach, a wave of contraction passing forward along that organ. A pair of cœca (*cæ.*, Figs. 3, 4, and 11) are found in the head, they open into the stomach at its commencement, just anterior to the great bend, and represents the more complicated liver of the higher Crustacea. Like the stomach they are furnished with muscular walls and a glandular epithelium. A movement of alternate expansion and contraction commingles their contents with those of the stomach.

The circulation in Daphnia is entirely lacunar, there are no such simple arteries even as those found in the Crayfish. The heart is lodged in a special chamber, the pericardial sinus (*p s*, Fig. 4), immediately in front of the upper end of the brood receptacle. Into this chamber the current of blood comes from the dorsal margin of the valves, and enters the heart by two lateral slits (Fig. 12). When from any cause the pulsation of the heart is retarded these slits may be seen to open and close alternately. From the heart the circulation proceeds into the head, bathing the great nervous centres, and passing into the labrum; from thence its course becomes much more obscure. A strong current, however, circulates within the valves, *i.e.*, between their double walls, and collecting at their dorsal margin, passes thence back to the heart. In the abdomen also a strong current is seen passing between the stomach and the body-wall towards the heart, before reaching which it seems to encounter another current coming from that organ; this latter, however, I believe separates on either side of the stomach and passes over toward the feet; currents are also seen in the pouches of the feet.

The heart is stated by Leydig to beat at the rate of from 200 to 250 times in a minute. The circulation, I have sometimes observed, is better seen in *Daphnia vetula* than in the other species, the corpuscles being larger. The blood-plasma, usually colourless, is under some circumstances found tinged with red to such extent, as to impart a ruddy hue to the water in which the creatures live; it is then singularly like the red fluid circulating in the closed vessels within the bodies of worms, except that the

latter does not contain corpuscles. With regard to their respiration, Baird calls the beautiful comb-like organs attached to the third and fourth pairs of feet, branchial plates. I think, however. that this must be altogether a mistake, if it implies that respiration takes place in them. They are surely unfitted for such a function, the hard slender teeth of the combs are but ill-adapted to bring the blood into contact with the external medium, and it is doubtful whether the corpuscles could pass into them. The soft integument of the pouches, where we see that circulation at least does certainly take place, appears much better adapted for the purpose. The combs may undoubtedly serve a subsidiary purpose by helping to cause the influx of water through the valves, though that would seem to be accomplished more by the action of the feet as a whole, than by that of the combs alone, which I believe are mainly instrumental in causing that accumulation of food substances between the bases of the feet, which is the first step in the act of feeding. Leydig considers, and I think with reason, that the respiratory process is also largely carried on within the valves, where a much larger circulation is maintained than seems to be necessary simply for the reparation of their tissues. The internal wall of the valves is delicate enough to subserve the purpose, and its extent is all that could be desired.

The nervous system, with the exception of the cephalic ganglia, has, I believe, not been made out. The latter are seen in the embryo to form a nearly continuous mass of nerve substance, in the front of the head; they subsequently become differentiated, as follows:—A cephalic ganglion or brain (*br*, Fig. 11) of a triangular shape lies in front of the œsophagus, the apex extending to the black spot (*s*), which has been supposed to represent the eye of Cyclops, and the ocelli of insects. Posteriorly this is continued as two nervous cords or crura, which embrace the labral muscle and the œsophagus, beyond which it cannot be traced. A smaller nerve mass, above this (*o n*), represents the united optic nerves of the eye. From the rounded extremity of the latter, nervous cords are given off to the several visual rods. A large ganglion (*g*), connected by cords with the brain, is given off to the superior antennæ, and another (*g′*) occupies part of the cavity of the labrum, thus indicating that both these are sensory organs.

The eye of Daphnia is one of the most interesting parts of its organization. At first sight it seems to form an exception to the usual form of the visual organs in the higher Crustacea, in two important respects: firstly, that it is single; and secondly, that it is apparently immersed in the body cavity, and thus dissociated from the epidermic tissues with which it is in other cases associ-

ated, and from which it derives its origin. Both these exceptions to the general rule are, however, I am convinced, apparent rather than real. I have repeatedly observed that the organ is double in the earliest stages of embryo life, the two pigmentary masses being perfectly distinct (see Figs. 16 and 27), and even in adults, if a good front view be obtained, the duplicature is still indicated by a notch; Leydig, too, I find, has observed such to be the case. This coalescence of the eyes seems to be in conformity with that general alteration which takes place in the body of the embryo, whereby it is reduced from a depressed larval form to a compressed condition in the adult. The remaining anomaly implied in the immersion of the eye within the body cavity, puzzled me for a long time, and was only revealed lately by the accidental circumstance of my having under examination a specimen deeply coloured by the red tinge which these animals sometimes exhibit, and which resides in the plasma or fluid of the blood. The eye is, as in all other cases, formed by an invagination of the epiblast, or external cellular tunic of the embryo; but the invagination in this case, I believe, proceeded farther than usual, so as to suffice not only for the formation of the organ, but for its reception in a cavity between it and the cuticle, or hard outer investment, This cavity becomes subsequently closed at the neck by the ingrowth of the epiblast, and forms an internal sac (*o s*, Fig. 11), in which the eye rests, and is balanced therein by muscular action. The sac is, I have reason to believe, filled with nothing but water. The cuticular covering, which in other Crustacea and in insects takes part in the formation of the corneal lenses, does not enter into the composition of the eye of Daphnia; no such lenses exist, a deficiency which necessarily follows the dissociation of the organ from its internal surface, and its mobile condition. It consists therefore of only the crystalline cones, and the rods surrounded by pigment cells; which form the epidermic structures in other arthropods, arranged in a nearly spherical form. In the embryo the eye is stationary, the sac not having yet been formed. It is, moreover, in close proximity with the optic ganglion, another point of *rapprochement* with the more typical forms, which, as development proceeds, disappears by the formation between them of a number of nervous cords, one apparently for each visual rod, thus providing for the subsequent characteristic mobility of the organ.

In the adult the optic sac is rounded in front, where it is in close proximity to the general epidermic layer underlying the cuticle, and its under surface towards the optic nerve is of a bulging form, somewhat like the surface of a cushion puckered in

places by strings attached to buttons. In fact, it is a hydrostatic cushion, inflated by the varying pressure of the blood in the body-cavity beneath it, the strings of the cushion being represented by contractile muscular fibres (*m''*, Fig. 11), four or more in number, arising from points of the exo-skeleton on either side the head. If the muscular action exceed the pressure of the blood on one side, the eye will be drawn round on its cushion toward that side, and *vice versa;* the movements of the eye are the result therefore of a beautiful balance of muscular action and hydrostatic pressure, I have met with similar examples in the insect world. The action of the muscles is probably entirely reflex, in common with most if not all the actions of the creature. I have, on former occasions, in the Note-Books of our Society, represented the muscles as passing round the eye like a rope round a pulley. This, however, I now see to be a mistake. A curtain of connective tissue passes down in front of the eye and confines the distending current of blood within its proper limits. It is only in those specimens whose blood has a red tinge, that the optic sac is rendered evident, its bulging lower surface having been previously mistaken by me for shreds of connective tissue. It may perhaps be thought strange that the optic sac should have become thus separated from the adjacent epidermic tissue of the head, and wholly immersed in the mesoderm of the body, but this is precisely what happens with the whole extent of the nervous cord itself, which by a like process of invagination, eventually becomes separated from the epiblastic tissues which gave it birth. I may add that at one period of its development the eye is seen to consist of a central mass of pigment (Fig. 22), surrounded by large transparent truncated cells, at the bottom of each of which is a crystalline cone in course of formation. Finally, I would ask whether the absence of corneal lenses, accompanied as we see it is by a mobile condition of the remaining visual elements, may not suggest a connexion between these two conditions, and throw some further light on the functions of the cornea in arthropods generally.

The reproduction of Daphnia has been well described by Sir John Lubbock, in the paper already referred to. All the stages of egg-development may be seen and studied with advantage. In some the rudiments of the eggs only are seen in the ovary, in others the eggs have passed from this into the brood-chamber or receptacle, and in others the egg-covering or vitelline membrane has been cast off, and the embryo young are gradually assuming the mature form. This constitutes the ordinary or agamic process of reproduction, and it will be noticed that I have spoken of these

bodies as eggs, thus following Sir John Lubbock's lead without prejudice to the disputed point as to whether they are properly entitled to the term, or can only be described as buds. Beside this, reproduction is carried on by what is believed to be a true sexual process, resulting in the production of ova which are destined for a slower course of development, and for that purpose are enclosed in a specialized portion of the brood-receptacle, called the ephippium (Figs. 2, 24, and 28). I will first describe the course of the agamic eggs, partly from Sir John Lubbock's observations, and partly from my own. The ovaries are placed on either side of the alimentary canal, and contain, surrounded by a cellular matrix, the bodies which Sir John calls ovarian masses (Figs. 9 and 14). They each contain from two to four or five cells, each with a large circular nucleus in the centre. Four or five of these usually follow each other, and it appears that those nearest the heart are earliest in their development. In course of time, all but one of the nucleated cells disappear from the ovarian masses. One, however, remains and becomes the germinal vesicle. Dark granules and oil-globules (Fig. 15) collect around it, and the yelk thus formed is of a greenish hue in all the specimens of *Daphia pulex* which I have specially examined. When one brood of young are on the point of passing from the receptacle into the water to commence an independent life, the ovary may be seen filled with a mass of these ova ready to take their places.

It would be interesting to observe how the ova make their way from the ovaries into the receptacle. Sir John Lubbock speaks somewhat doubtfully of their passing out near the heart, and I should think it probable that such is the case, inasmuch as the more advanced eggs always appear to be in this situation, but I have not, neither has Sir John, been able to detect any duct by which they make the passage. The eggs, when they have passed into the receptacle, are surrounded by a covering which Sir John Lubbock describes as the vitelline membrane, and the contents appear to me to be granules and small cells, having a large and conspicuous oil-globule in the centre (see Fig. 23). Curiously enough, the eggs are now of a reddish-yellow hue, at least, in *Daphnia pulex*, where alone I have particularly observed them, the green hue subsequently again prevailing through the multiplication of green cells, each containing an oil-globule. At this time, the blastodermic layer is, I believe, in course of formation, but my optical means will not allow me to speak with certainty on the point. The green cells which Sir John Lubbock describes as yelk-masses become larger and are aggregated round the large,

central oil-globule. They appear to me to be mesodermic cells, analogous to the fatty rete of insects; and, like them, they are more abundant in the earlier stages than in the adult, and are largely utilized in the elaboration of the structures which specially characterise the adult, where they become consequently less conspicuous.

A primary separation of the head from the body can be seen even before the embryo quits the egg, which it now does, the cast vitelline membrane being frequently seen, together with the embryos, in the receptacle. The embryos (Fig. 17) are now of a flattened or depressed form, strikingly in contrast with the compressed condition of the adult, the diameter from the dorsal to the ventral surfaces being much less than that from side to side. In the centre is seen the large oil-globule, and the green cells by which it is surrounded. The embryos are enveloped at this time in a delicate skin (*sk.*, Fig. 17), of which Sir John Lubbock says that as it was not present when the egg was laid, it must have been formed since, and he draws the conclusion that the young Daphniæ, so far from undergoing no metamorphosis, do in fact enter the world in a very rudimentary condition, and that only after the first change of skin do they assume the distinctive characters of the genus. This skin is subsequently shed, but previously to that we perceive the rudiments of the anterior limbs, viz., the two pairs of antennæ, the mandibles, and the first pair of maxillæ, all in the form of rounded buds, except the great antennæ, which are longer. The remaining limbs are as yet only indicated by notches. In the greater development of the anterior limbs, the animal certainly bears a resemblance to the *Nauplius* form of Cyclops and many other Crustacea.

At this time, too, we may discern the carapace as a flat plate, covering little more than half the body (Fig. 20), somewhat notched behind; while from the centre of the notch proceeds the terminal spine, no appearance as yet being visible of any approximation to the lateral margins, such as that which subsequently converts it into a bivalve shell. The enveloping skin is now cast off, as was previously the vitelline membrane, and development rapidly proceeds. Two patches of pigment indicate the future eyes; the heart begins to beat, at first slowly, and part of the alimentary duct can now be discerned; the large oil-globule has disappeared, but the smaller cells are still very conspicuous. The posterior limbs are gradually formed, and the creature is ready for an independent existence. Such is the course of what Sir John Lubbock calls the agamic eggs. The ephippial eggs pursue a course differing in many important respects, but I have not been

able personally to make any satisfactory observations. Sir John Lubbock says they are produced from two determinate ovarian masses in the lower part of the ovary, one on each side; thus, there are never more than two to fill the two ampullæ of the ephippium. Their development in the ovary is not accompanied by the presence of oil-globules, as is the case with the agamic eggs, and they are much darker in colour (see Figs. 13 and 6). Sir John Lubbock has witnessed the passing of the yelk-mass from the ovaries into the receptacle, where they are received into a specialised portion indurated by a dense cellular growth (Fig. 28), which speedily closes upon them. They are then cast off with the next moult, secure in their covering against the adverse influence of drought, or, as some say, of the winter's cold, but the former appears to me the more probable hypothesis, inasmuch as I have found the ephippia produced in the greatest abundance in the months of May and June, when the concurrent abundance of males gives weight to the belief that the eggs so produced are true sexual products. The position of the testis in the male corresponds to that of the ovary in the female, and is shewn at *t*, Fig. 1.

EXPLANATION OF PLATES XVIII. and XIX.

Fig. 1.—Male *Daphnia psittacea*, showing *s a.*, large superior antennæ; 1, first pair of feet, with hook and filament; *md.*, mandible; *t.*, testis.

,, 2.—Female *D. psittacea*: *h.*, the hood; *s g.*, the shell-gland; *f f.*, lines of fission of the carapace; *eph.*, ephippium with two eggs.

,, 3.—Front view of head of *D. vetula*: *cœ.*, the cœca; *lr.*, the labrum; *x x.*, jointed organs at base of the great antennæ, the rest as before.

,, 4.—Female *D. psittacea*, showing agamic eggs in brood receptacle: *m m m.*, muscles of antennæ; *f p.*, dark mass of food particles; *ht.*, heart; *p s.*, pericardial sinus; 1, 2, 3, 4, 5, pouches of five pairs of feet; *a.*, anus; *r.*, rectum; *pr.*, process of abdomen retaining eggs.

,, 5.—Portion of shell-gland of *D. pulex.*

,, 6.—Ephippial egg of *D. psittacea.*

,, 7.—Diagram, section of carapace, showing double wall with blood globules between.

,, 8.—Ditto, showing ephippium closing upon the egg.

Fig. 9.—Ovarian mass, with nucleated cells.

,, 10.—Deposit of lime from carapace.

,, 11.—Head of *D. pulex*: *o s.*, optic sac; *m.*, muscle of labrum; *m'*, muscle of œsophagus; *m''*, one of the muscles of the eye; *br.*, brain; *o n.*, optic nerve; *g*, ganglion of superior antenna; *g'*, ganglion of labrum; *œs.*, œsophagus; *st.*, stomach; *mt.*, mouth; *s.*, dark spot; the rest as before.

,, 12.—Heart, showing slit.

,, 13.—Ephippial egg from ovary of *D. psittacea.*

,, 14.—Ovary of *D. psittacea*: *m m.*, cells of matrix; *o m.*, ovarian masses. This is as seen immediately after the passage of the mature eggs into the brood receptacle.

,, 15.—A more advanced condition of the ovary, showing six agamic eggs, containing oil-globules and granules.

,, 16.—Double eye-spots in embryo of *D. vetula.*

,, 17.—Embryo of *D. psittacea* highly magnified, showing *s a.*, superior antennæ; *i a.*, inferior or large antennæ; *lr.*, labrum; *md.*, mandibles; *g.*, large oil-globule; *mc.*, green cells of mesoderm; *sk.*, enveloping skin.

,, 18.—Embryo *D. psittacea*, showing large antennæ and coiled-up spine, *sp.*

,, 19.—Comb, or so-called branchial plate of *D. pulex.*

,, 20.—Early stage of embryo of *D. pulex*, showing short flattened carapace and spine.

,, 21.—*D. rotunda*, showing large reticulations at anterior margin, passing into smaller ones behind, and irregular puckerings where the ephippium has been cast off.

,, 22.—Embryo eye of *D. pulex*, with truncated cells and incipient crystalline cones.

,, 23.—Agamic egg of *D. pulex*: *v m.*, vitelline membrane; *bl.*, blastoderm; *g.*, oil-globule, surrounded by cells.

,, 24.—Section of ephippium, showing inner and outer case with egg.

,, 25.—Portion of carapace of *D. rotunda*, showing *f f f.*, lines of fission.

,, 26.—Portion of stomach of *D. psittacea*; *m l.*, soft inner membranous lining.

,, 27.—Double embryo eye of *D. psittacea.*

,, 28.—Ephippium, showing cellular induration.

On the Size of Dust-Particles of Wheat and Coal.

By Hahnemann Epps,

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ATTENTION may with advantage be directed to the general subject of subdivision, when it is remembered what important results are caused by the minute dust of many substances. I will now refer, however, only to the powerful agency exerted by such inert substances as the minutest motes of wheat and coal. The subject of dangerous dusts has been treated of by such eminent men as Faraday, Lyell, Galloway, Abel, and others.

It is well known that the greatest risks in a flour-mill arise from the development of as much heat as will ignite the fine particles of flour. This heat is due to the (temporary) arrestment of the supply of grain, or to the use of naked flames when the air is charged with flour-dust, or "stivings." The conditions under which a consequent liability to explosion arises are scarcely at present fully defined; indeed, it is unfortunately the conviction of many practical millers, that whatever precautions may be taken, the risk of explosion from such causes can be only minimized. Explosions and fires in flour-mills from this cause do every now and then attract attention, causing lamentable loss of life as well as of property.

Again, it is pretty well established that coal-dust plays an important part in the serious explosions that unfortunately are of such frequent occurrence in coal-mines. From the time of Faraday (1845) to the present day, this conviction has been gradually strengthening. It had often been noticed that the percentage of fire-damp requisite to cause the air of a mine to become explosive was by no means constant, and that the same mixture might or might not be liable to explosion according to circumstances. Gradually, an impression which had long been felt, that the explosive property was due to a third factor—coal-dust—became strong, and has now at length been demonstrated by experiment.

It will, therefore, be a subject of great interest to the micros-

copist to observe what variations or similarity in the size of the dust-particles of the two substances, wheat and coal, there appears to be.

I have been unable to gather the dust required for my purpose, either in the coal-mine or in the flour-mill, and, therefore, have had to content myself with a simple mode of collection. In the case of coal, I have collected the dust on shelves placed at fixed distances from the coal-trap of a large cellar, during the unloading of several tons of coal; and in the case of wheat-flour, in a similar manner during the sifting of flour in a confined space. After collecting the samples of dust, I have, by gentle tappings, transferred minute portions to glass slips for examination, taking care that the particles have been evenly distributed on the surface. The microscopical examinations have been made with a 1-inch objective, A eye-piece, and stage micrometer, and by reflected light. In cases where variation in the diameters of particles (which in both cases are very rugged) has been observed, as, *e.g.*, of an oblong spheroid, I have recorded the smaller diameter. I have chosen for examination groups of about 250 particles, evenly distributed over the field, and have endeavoured to secure the same conditions of observation in each case.

WHEAT-FLOUR.—I have examined three samples:—(1) fine household flour, (2) dust from it collected 4 feet off, and (3) dust from it collected 6 feet off.

1.—FLOUR.		2.—DUST at 4 ft.		3.—DUST at 6 ft.	
No. of particles.	Fraction of inch.	No. of particles.	Fraction of inch.	No. of particles.	Fraction of inch.
3	=·00250	2	=·00250	0	=·00250
6	=·00150	5	=·00150	0	=·00150
11	=·00100	8	=·00100	4	=·00100
30	=·00075	20	=·00075	8	=·00075
50	=·00050	30	=·00050	13	=·00050
50	=·00025	40	=·00025	25	=·00025
50	=·00015	55	=·00015	45	=·00015
50	=·00010 (& less)	90	=·00010 (& less)	155	=·00010 (& less)
250		250		250	

COAL-DUST.—I have examined also three samples from Welsh coal, collected at distances of 4, 6, and 11 feet.

1.—DUST at 4 ft.		2.—DUST at 6 ft.		3.—DUST at 11 ft.	
No. of particles.	Fraction of inch.	No. of particles.	Fraction of inch.	No. of particles.	Fraction of inch.
9	=·00250	2	=·00250	0	=·00250
16	=·00150	8	=·00150	4	=·00150

40='00100	12='00100	7='00100
70='00075	28='00075	9='00075
45='00050	40='00050	20='00050
25='00025	55='00025	35='00025
20='00015	45='00015	75='00015
25='00010 (& less)	60='00010 (& less)	100='00010(& less)
250	250	250

The results, we can see, express what might have been expected, especially the greater absence of the larger particles at the longer distances. To secure accuracy, I have modified my first results by fresh examinations. It has been impossible to estimate exactly the number of particles of the smaller sizes, but the numbers expressed may, I think, be taken as approximately correct. The question, "What are the smallest sizes in the two dusts?" I will not enter upon now; I have observed particles of ·00003=$\frac{3}{100,000}$ inch, even with a low power, and no doubt such as travel great distances will seldom exceed ·00005.

Another question that I cannot at the present time discuss, is the reason why such dust as that of wheat and coal should be so explosive. I will therefore conclude this hasty sketch with a quotation from a special report on the subject, prepared for the Board of Trade, which gives a forcible explanation of the matter:—"The finely-divided dust-particles being diffused in the air, are each brought into intimate contact with the oxygen which is necessary for their combustion, and consequently, when ignition occurs, it is very rapid. The particles near the flame are ignited, and in their turn ignite the neighbouring particles, which again ignite the adjacent ones, until the whole chamber is a body of flame." It seems to be a matter of extensive surface, and therefore of rapid combustion.

Notes on the Bursting-Point of some Starch-Cells.

By W. J. Dibdin, F.I.C., F.C.S. Plate 17.

THE following record of a series of experiments, conducted with a view of ascertaining whether any reliable information could be obtained from the bursting-point of various Starch-cells as a means of assisting in their identification, may probably be of interest, although the results are not of the analytical value that it was hoped they would have been.

The arrangement used for ascertaining the temperature was

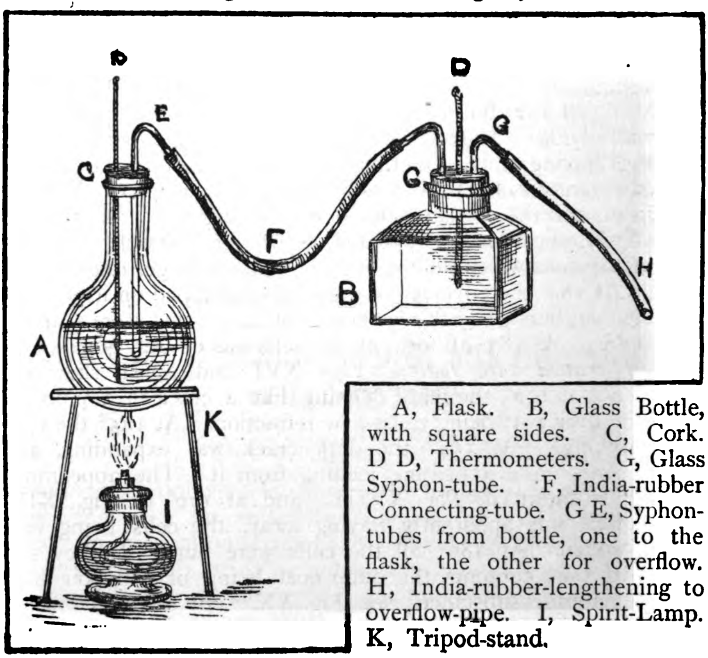
very simple, consisting of a flask, A, such as chemists use for wash-bottles, having a syphon-tube, E, connected with a square white glass bottle, B, which rested on the stage of the microscope, inclined at an angle of 45°, one of its sides thus serving as a hot stage. Another tube, G, passed through the cork of this bottle and served as a waste-pipe, in order to keep up a constant flow of water from the flask through the bottle. Thermometers, D D, were placed in the flask and in the bottle. Heat was then applied to the flask, and so a constant stream of water, gradually increasing in temperature, was kept flowing through the bottle.

The starch to be examined was then mixed with a little water, and placed on a thin cover-glass, inverted on the side of the bottle, so that the Starch-cells were in immediate contact with the bottle, and protected by the cover-glass.

This arrangement was found to work very well. The error due to the difference of temperature between the water in the bottle and the surface of the glass was evidently very slight; but whatever it was, the results were all strictly comparable, as the same apparatus was used for all the experiments.

The accompanying sketch will shew at a glance the arrangement of the hot stage.

Fig. 19.



A, Flask. B, Glass Bottle, with square sides. C, Cork. D D, Thermometers. G, Glass Syphon-tube. F, India-rubber Connecting-tube. G E, Syphon-tubes from bottle, one to the flask, the other for overflow. H, India-rubber-lengthening to overflow-pipe. I, Spirit-Lamp. K, Tripod-stand.

RICE-STARCH. *First Experiment.*—At 165° a white spot like a nucleus appeared. For the appearance at 176° see Fig. I. Larger particles were expanding at 178° and losing form. At 179° many cells were very attenuated; see Fig. II. At 181° most of the cells were dissolved. At 185° all cells were gone. No fracture was distinguishable during dissolution.

Second Experiment.—Appearance at 140°, see Fig. III. At 150°, see Figs. IV. and V. At 169°, Fig. VI., when the opening gradually spread out, Figs. VII. and VIII., and became very faint. At 179° nearly all the cells were dissolved. Fig. IX. shews another cell at 181° like a film. All cells had burst at this temperature.

Maize Starch.—At 100° the hilum was distinctly visible, some cells having a distinct opening, Fig. X., but most having only a bright spot. No plications were visible. At 120° the hilum of most of the large cells had opened out into a star-shape; see Fig. XI. These cells burst very much like those of Wheat-starch. At 138° some cells had burst all round the edge, see Fig. XII.; the hilum of others opening out. Fig. XIII. shews a large cell at 148°. At 162° the small cells had lost form. At 172° the cells were rapidly swelling and losing angular form. At 178° folds were appearing on the envelope. At 182° the cells were very attenuated and apparently empty.

Sago Starch.—The appearance at 100° is shewn in Figs. XIV. and XV. At 152° the markings from the hilum were opening out and multiplying. At 160° the cells were swelling rapidly and the markings fraying in all directions—similarly to potato starch. At 165° the larger cells were much expanded and cracked in all directions, and the smaller cells were opening out. As the cells swelled, the plications disappeared, as in potato starch. At 176° the smaller cells were swelling rapidly and the larger ones attenuating. At 180° the envelope of the cells overlapped on itself. All the cells had burst, and the envelopes of larger ones were scarcely discernible. At 183° all form of the cells was entirely gone.

Sago treated with Iodine.—Figs. XVI. and XVII. shew the appearance at 112°, the mark opening like a crack in a piece of glass, the dark part being caused by refraction. At 145° the cells were swelling. At 154° the dark crack was expanding, and smaller ones were appearing leading from it. The appearance at 168° is shewn in Fig. XVIII.; and at 170° in Fig. XIX. The cuticle was apparently fraying away, the cells being very much swollen. At 180° all the cells were burst, but they still contained their contents, the outer coat being of a darker blue than the interior substance; see Fig. XX. All the cells opened like a piece of jelly pulled asunder, the Iodine apparently binding

the amyline together and preventing dissolution; see Figs. XXI. and XXII. At 194° the cells had not collapsed, ebullition for several minutes being required to completely distend and empty them.

Wheat-Starch.—At 134° a nucleus and concentric rings were apparent, and the corpuscles were swelling. At 140° a nucleolus was very distinctly seen. At 150° a few cells were burst; see Figs. XXIII, XXIV., XXV., XXVI. At 158° some large cells began to lose shape. For appearance at 164° see Figs. XXVII. and XXVIII.; and at 174°, Fig. XXIX. At 176°, see Fig. XXX., and at 177°, Fig. XXXI. At 180° the form of the cells was beginning to disappear. After remaining at 180° a few minutes, all the cells appeared to have lost their original form, and their contents were dissolved out.

The chief characteristic of Wheat-Starch was the gradual swelling of the cells without distinct openings appearing, as in other Starch-cells; only one exception to this was seen at 164°.

Potato-Starch.—At 140° the cells began to split open; see Figs. XXXII. and XXXIII., the fracture commencing at the hilum. At 153° the centre of the cell was gradually opening out, Fig. XXXIV. At 158° all the large cells were burst. At 170° all the large cells were fully open. At 180° all the large cells were gone, and at 184° all the cells were gone.

Potato-Starch, after being exposed to a moist atmosphere for some days.—Very few of the cells shewed concentric rings, but a curious fracture at the hilum had occurred, from which other fractures extended. These fractures were of a very interesting character, being circular and saucer shaped, but with the centre raised; see Fig. XXXV.

As the cells rolled in the liquid, it was distinctly seen that this fracture was circular (see Fig. XXXVI.), having a central point with radiating markings, and that it was in all cases in the longitudinal axis of the cell, a little above the centre, coinciding with the hilum.

From the foregoing results it is evident that a temperature of 180° F. is sufficient to entirely dissolve the various starches experimented with, but, unfortunately, nothing of value to the analyst has been obtained, although the work may be of sufficient interest to place the results upon record.

On the Salmon-Disease.

IN the Proceedings of the Royal Society for the current year, there are recorded some experiments by Professor Huxley, and his observations thereupon, with reference to the parasitic fungus, *Saprolegnia*, which has of late wrought so much damage among the Salmon of our rivers; and as the subject is interesting, both economically and microscopically, we reproduce them here for the benefit of our readers.

The body of a recently-killed common House-Fly was gently rubbed a few times upon a patch of the diseased skin of a salmon; and it was then left for a while in a vessel of water, upon the surface of which it floated, being buoyed up by the air contained abundantly in the tracheæ. In the course of about 48 hours, numerous white, cottony filaments made their appearance, set closely together side by side, and radiating from the body of the fly in all directions, so that it presently became inclosed in a thick, white, spheroidal shroud, having a diameter of as much as half-an-inch. These filaments being specifically heavier than water, they gradually overcome the buoyancy of the air in the tracheæ of the fly, and the whole mass sinks to the bottom of the vessel. The filaments are very short when they first become discernible; and they usually make their appearance where the integument is softest, as, *e.g.*, between the head and thorax, upon the proboscis, and between the rings of the abdomen. In their size, structure, and reproductive arrangements, they are precisely similar to the *hyphæ* of the salmon-fungus; and the characters of both alike prove that the fungus is a *Saprolegnia*, and not an *Achlya*. It may, moreover, be easily shown that the body of the fly became infected solely by spores which adhered to its surface when rubbed over the diseased skin of the fish. These spores have, in fact, germinated, and their *hyphæ* have penetrated the cuticle of the fly, notwithstanding its comparative density; and have then ramified inwards, growing at the expense of the nourishment supplied by the fly's tissues.

Experiments of this kind, variously repeated with all needful precautions, lead us to the important practical conclusion that the cause of Salmon-disease may exist in all waters in which dead insects, infested with *Saprolegnia*, are met with;—that is to say, probably in all the fresh waters of these Islands, at one time or another; while, on the other hand, *Saprolegnia* has never been

observed on decaying bodies in salt water. Thus it becomes, to say the least, a highly probable conclusion that the origin of the disease is to be found in the *Saprolegniæ* which infest dead organic bodies in our fresh waters. Neither drought, pollution, nor overstocking will produce the disease, so long as *Saprolegnia* is absent; though doubtless these conditions will favour its development or diffusion wherever the fungus already exists.

The results, then, of observations and experiments recently made appear to justify the following conclusions:—

1.—That the *Saprolegnia* attacks the healthy, living salmon exactly in the same way that it attacks the dead insect; and that it is the sole cause of the disease, whatever other circumstances may—in a secondary degree—assist its operations.

2.—That death may result, without any other organ than the skin being attacked; and that, under these circumstances, it is the consequence partly of the exhaustion of nervous energy through the incessant irritation of the felted mycelium, with its charge of fine sand,—partly of the drain of nutriment directly and indirectly caused by the fungus.

3.—That the penetration of the *hyphæ* of the *Saprolegnia* into the skin renders it at least possible that the disease may break out in a fresh-run salmon without re-infection.

4.—That *Saprolegnia*, the cause of the disease, may flourish in any fresh water, in the absence of salmon, as a saprophyte upon dead insects and other animals.

5.—That the chances of infection for a healthy fish entering a river are enormously increased by the existence of diseased fish in that river; since the bulk of *Saprolegnia* on a few diseased fish greatly exceeds what would exist there without them.

6.—That, as in the case of the potato disease, the careful extirpation of every diseased fish is the treatment theoretically indicated; though it may not be worth while in practice to adopt that treatment.

Pond-Hunting in Winter.

By E. Wade-Wilton.

IT seems to be the general opinion amongst microscopists that ponds will not repay for the trouble of an examination in the winter months. This "fireside theory" is as absurd as it is erroneous.

In the coldest part of last year, the writer was out collecting microzoic life, when he met a friend, who asked with amazement, "What! haven't you got your stock of specimens for the winter yet? How can you possibly supply your customers?" This friend was prevailed upon to watch the collecting-operations, and was led to express his belief, after being shown many forms in great abundance, which he had looked upon as very rare, that the winter was after all the best time to collect.

During the winter months, owing to the difficulty of obtaining specimens from his regular collectors, the writer is often obliged to collect his own specimens, or suffer the greater inconvenience of not being able to meet the demands of his business, and he feels great confidence in the truth of the remarks to be made in this short paper.

There are *seasons* in microscopical work as perceptible as the seasons of the year. The summer is devoted to "Pond-Hunting," and the winter to mounting or to mounted objects; this is most unsatisfactory and quite unworthy of a practical worker. If "Pond-Hunting" is only prosecuted for a certain part of the year, what observations can be made during the rest of the year? The least observant student will see that "the habits of animals will never be thoroughly known till they are observed in detail. Nor is it sufficient to observe them now and then; they must be closely watched, their various actions and behaviour under different circumstances carefully noted, and especially those movements which seem to us mere vagaries, undirected by any suggestible motive or cause, well examined. A rich fruit of results, often most curious and unexpected, and often singularly illustrative of peculiarities of structure, will, I feel sure, reward any one who studies living animals in this way. The most interesting parts, by far, of published natural history, are those minute but most graphic particulars which have been gathered by an attentive watching of individual animals." *

We make no apology for quoting Mr. Gosse at so great a

* Gosse, "The Aquarium," in preface.

length, but most sincerely wish that our (so-called) practical microscopists would follow his advice more fully.

Those microscopists who keep an aquarium, and are in the habit of searching in it for living microscopic animals, must have noticed that when there is a superabundance of decaying vegetable matter in the aquarium,—that is, when there is only so much decay taking place in the water as will not interfere with the health of the higher animals inhabiting it,—the microscopic animals are found in the greatest abundance. The Polyzoa and Tubular Rotifera, especially, are found to be in the best condition under these circumstances.

The winds of October and November drive a large quantity of dead leaves and other lifeless vegetable-matter into the ponds, which decaying, form a black offensive ooze. This is generally to be found congregated in the shallowest part of the pond, covered only by a few inches of water.

In this ooze, the prevailing forms of animal life will probably be—*Chilomonas* and *Amœba*, in great abundance, *Trachelocerca olor*, *Euglena denses*, and *E. pyrum*.

These may generally be found in this part of the pond, in a very fine and healthy condition. If the pond is of moderate size, some portions of the water will be found quite "sweet," and yet containing a large amount of the "lower forms," especially if they are partially shaded from the light; we may look for *Limnias ceratophylli*, *Stephanoceros Eichornii*, *Floscularia ornata*, *Melicerta ringens*, and various other "hard-feeding" Rotifers. (We enumerate these because they are so popular, and well-known to every microscopist).

Sometimes in ponds, but more generally in rivers, canals, or ditches, we find large quantities of the "American Water-Weed," "*Anacharis Alsinastrum*," which in the summer-time almost chokes them. In the winter the greater part of this plant dies down, forming a light-brown deposit on the surface of the mud. If the old stems are examined, a host of interesting specimens will be obtained.

The following will show our success on one occasion :—

"Nov. 18, '81.—Meanwood arches, took in quantity :—*Philodina roseola* and *Brachionis pala; Mastigocerca carinata*, *Polyarthra platyptera*, *Actinurus Neptunius*, *Stentor niger*, and *S. Mülleri; Actinophrys sol; Trachelius ovum*, *Coleps hirtus*, *Tardigrada*."

The above is extracted from some notes of 1881. The organisms were obtained from one ditch, in four gatherings, as shown.

The Algæologist finds a rich reward for his trouble in searching the mountain-streams, and moorland tarns and ponds in winter,—perhaps at no time in the year is there so rich a harvest

to be secured. From personal experience we can say but little of the algæ to be obtained in winter, but a friend writes:—"I always turn out whenever the ponds are accessible in the winter—it is *the* harvest-time."

Volvox, *Chara*, *Nitella*, etc., may all be obtained in the depth of winter, and the supply of specimens which can be obtained at that season by an ardent hunter is unlimited.

We may perhaps be allowed to say that for comfort it is desirable to have such apparatus only as can be manipulated, whilst wearing a pair of thick gloves, good strong boots, not omitting a pipe, plenty of tobacco and matches—no cigars. Thus equipped, we can promise the earnest pond-hunter a rich reward.

We do not wish to say that winter is the best or only time to collect, but that winter-collecting is very important and should not be neglected; in collecting at this time of the year, we must expect to suffer some discomfort.

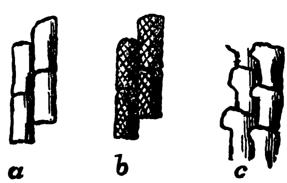
For those who are unable to face the winter wind, we purpose at an early date, with the Editor's permission, making a few suggestions on the "Microscopist's Breeding-Tank."

Leeds.

Selected Notes from the Society's Note-Books.

BOTANICAL.

Fig. 20.



Sphagnum Moss.—On this moss the utricles, which form a very good distinguishing feature, especially to beginners, may be very distinctly seen. In the present instance the leaves have been pulled off the base of the stem for the purpose of showing them more clearly. For instance, in *Sphagnum rigidum* the utricles are clean, as in *a*, Fig. 20; in *S. cymbilifolium* they have spiral fibres inside, as in *b;* in *S. molluscum* the ends are recurved, as in *c*. A dark-ground illumination is best for the examination of mosses.

W. H. CHEESMAN.

As it may not be generally known that it is to the Sphagnums that we are principally indebted for our peat, I will quote what Huxley says on the subject :—

"In this part of the world, the principal peat forming plants are certain mosses known to botanists under the generic name of *Sphagnum*. The stems of the Bog-Moss die away in their lower part, while the upper portion continues to grow freely. The interwoven dead portions form a tangled mass, which holds water like a sponge and favours the growth of the above moss. Remains of other plants become mixed with the moss, and contribute to the formation of the peat, while trunks of trees occasionally get imbedded in the bog; muddy matter is likewise washed during floods, and helps to consolidate the felted mass, and to produce a deposit of considerable firmness. The rate at which peat grows varies greatly under different conditions, but some notion of the rate may be gained from the fact that Roman remains, and even Roman roads, have been found beneath eight feet of peat. In Ireland peat bogs are so abundant that they cover about one-tenth of the entire surface of the country; and, in some cases, the peat may be as much as forty feet in thickness."

W. H. READ.

The slide under notice, containing as it does six species of *Sphagnum*, is a very instructive one, and forms an example of educational mounting that I would strongly recommend our members to copy. Seeing six different kinds together, we are enabled to note the *very* marked similarity in the shape of the cells, though each species has its own distinctive form. I should have thought that the form of the cell and shape of the leaf would be an easier means of determining the species than the utricles of the stalk. Let me point out this, taking the mosses as they appear on the slide :—

1.—*Sphagnum cymbilifolium*.	Leaf—Roundish egg-shaped.
2. „ *molluscum*.	Round egg-shaped.

The special difference between these two consists in that the first has glands (papillæ) at the back of the apex of the leaf, which are wanting in the second.

3.—*Sphagnum acutifolium*.	Leaf—Pointed egg-shaped, with perichætial leaves, small.
4. „ *compactum*.	Egg-shaped, with blunt point.

5.—*Sphagnum plumosum.*	Leaf—Perhaps this is a variety of *S. cuspidatum* called "Feathery Bog-Moss," and if so the form of the leaf is lanceolate.
6. " *squarrosum.*	Elliptic, with broad base tapering to a point.

The capsules of these mosses, observed with paraboloid or spot-lens, is a lovely object, like a goblet of ebony on a silver stem. Linnæus states that the Lapland matrons dry these mosses and lay them in their children's cradles to supply the place of bed, bolster, and every covering; and being changed night and morning, it keeps the infant remarkably clean, dry, and warm. It is sufficiently soft of itself, but the tender mother, not satisfied with this, frequently covers the moss with the downy hairs of the reindeer, and by that means makes a most delicate nest for the new-born babe.

HENRY BASEVI.

I regret that Mr. Cheesman did not carry his diagnosis further, and point out, in his own way, the distinctions between all the species on his slide. It is obvious that Col. Basevi's remarks point out a valuable help in the determination of species, and combined with the form and nature of the utricle, the determination of species is much simplified. I find great difficulty in comparing cells such as those of mosses, where the forms run so much alike, and any additional characteristics are most welcome.

THOMAS STEEL.

ZOOLOGICAL.

Birds'-Head Processes in Gemellaria.—Are these birds'-head processes parasites? I have met with them on different zoophytes. On one occasion I saw a small eel seized, and the muscular beak retained its hold till the death of both. On trying to mount them together, they separated, showing the eel's body deeply indented by the beak.

A. NICHOLSON.

Birds'-Head Processes are not parasitic. They serve the purpose of police, to make odd things in the shape of spores,

embryos of all sorts, etc., that would settle on the polypidom, and so cause injury to the *body politic*, "move on." On carefully reading Mr. Nicholson's remark, it will not be understood that the eel, *Anguillula* (T. W.) and *Avicularium* died together, the latter becoming detached after death from exhaustion, but only that on attempting to mount the object, the *Anguillula* slipped from the grasp of "X 249," his life having come to an end, I suppose, from the strong dose of poison administered in the guise of "*mounting fluid.*" Most of the Polyzoa have these processes, their soft parts are continuous with the soft parts of the zoophyte to which they belong, and correspondingly nourished. Some Polyzoa have, instead, *vibracula*, or bristles, which in life sweep constantly over the surface. Molly with her broom always at work, you see, to keep things clean and tidy. In some instances, both forms are found on the same polype, in others only one; they furnish a valuable help in classification. The pedicellaria of the *Echini* and many star-fishes (see Herapath in Quart. Jour. Micro. Sci., 1865, p. 175) are precisely analogous.

TUFFEN WEST.

A paper, with a plate of illustrations, on *Avicularia* will be found in Lon. Micro. Jour., 1854.

A. NICHOLSON.

Atax, *a Water-Mite found on a living Gnat.*—Mr. Alfred Atkinson (President) circulated a slide of above, which induced the following remarks from Mr. Ball, a member well up in Acarea:—"Mr. Atkinson's mites are particularly interesting from the fact of their having been found upon a gnat. They certainly were "fish out of water," since in the first place they are not parasitic mites at all, nor are they acari as stated on the slide. They are the young of a species of *Atax*, a mite which swims freely in the water. The most familiar example of the genus is a beautiful scarlet mite, which may often be seen spinning its way through clear water in ponds, etc. I should like to know whether the gnat was a dead one picked up on the surface of some water." To this Mr. Atkinson replied.

Hogg says of "*Hydrachnidæ*":—"In their young state they attach themselves parasitically to aquatic animals." These mites were certainly parasitic when I found them. They entirely covered the posterior portions of the body of the insect, which was taken alive, and lived under an inverted wine-glass several days. They are young mites, as they have not yet developed the fourth pair of

legs. It is possible that they may have lived on the gnat larva, or have become attached to the insect at the time of its last metamorphosis.

These mites are the larva of *Atax histrionicus* or *Hydrachna histrionica* of Hermann. They are very common in tanks and stagnant water, and attach themselves to almost anything that has been or is alive in the water.

C. H. GRIFFITH.

Larva of Ant-lion.—This larva has no mouth, but instead two horny fangs resembling jaws, which are toothed upon the inner margin, and terminate in sharp points. These jaw-like appendages are hollow, and serve not only for seizing but for sucking the juices of the insects, for which the animal so cleverly contrives a pitfall. The mandibles in front of the head are curiously made, being *deeply* grooved throughout their entire length, and permit the maxillæ, or inner pair of jaws, to play up and down them.

E. E. JARRETT.

Macrotoma Plumbea.--Mr. E. Smith has found this insect, which is very much like the *Podura*, only about three times as large, in two different places:—1st, he finds it plentifully in his cellar—those found there are lead-coloured; 2nd, on a wall at the bottom of his garden—these assume a black tint. Is the difference in colour due to the light in which they live, the structure of the scales and the insects themselves in all other respects being identical?

E. SMITH.

Colours of Beetles' Wing-Cases.—This question is a much wider one than is supposed by many. Diffraction is in many cases an important factor, in others it is subordinate to *thin plate interference*, and both are frequently controlled, or at all events modified, by the presence of various colouring matters. Thus it happens that the phenomenon is a somewhat complicated one, and any one elytron must be taken on its own merits and subjected to careful optical and chemical examination before a full explanation of its chromatic phenomena should be ventured upon. There is work here for the student of insects where he has an almost unworked field, and the certainty of doing new work. I have myself made a partial examination of the wing-cases of *Cantha-*

ris vesicatoria, whose colours I refer to diffraction, slight "thin plate action," and the pressure of leaf-green or chlorophyll. The elytron of *Corypheria Africana*, a beautiful beetle from Old Calabar, which appears red in one light and blue in another, cannot fully be investigated in its mounted condition; but I suspect a large part of its colour is due to a green resinoid substance, which could probably either be dissolved out by Ether, Chloroform, or CS 2. The iridescence is due to interference by diffraction. For this see "Brewster's Optics," "Ganot's Physics," or "Deschanel's Natural Philosophy."

H. POCKLINGTON.

P.S. Nov., 1882.—The Editor has been good enough to allow me to supplement the above very brief note by an abstract of an article contributed to the "Pharmaceutical Journal," March 1st, 1873, on the "Colour of the Wing-Cases of Cantharides." *Cantharis vesicatoria* is furnished "with two wing-covers of a shining metallic green colour" (such is the B.P. description of them), but when examined by lamp-light, the colour of the case varies very sensibly, as the positions of the lamp and wing-case are changed, and these variations are intensified if the wing-case be immersed in alcohol or carbon-bisulphide (CS_2). If the test-tube containing the insect be held so that the lamp is between, and nearly in a line with it and the eye, the colour appears no longer green, but rich golden copper; changing the position of the tube, the colour passes into yellow, and quickly to green; changing the position further, the colour becomes a beautiful blue and then purple. Examining the wing-case by polarised (incident) light, it is found that the colour is nearly quenched in two positions of the polarising prism, as it is rotated on its axis. Examining the blue light with the Nicol prism, we find that in two positions of the prism the colour is again nearly quenched, and that these positions are complementary to those the prism occupied in the former experiment. The blue colour is more intense by daylight than by lamp-light, and much more intense than either by magnesium light. The blue is not a pure blue, but contains a little green. This blue colour is probably due to fluorescence and diffraction. The small balance of light not wholly quenched by the prism was examined, as it appeared to exhibit traces of a definite colouring matter, to which its evident green colour was due. Specimens were placed in ether, alcohol, chloroform, and carbon-bisulphide, and the fluids examined spectroscopically. A sharply-defined band was seen in the red, a shaded band in the green, with partial passing into general absorption of the blue and violet. This

spectrum is substantially that of so-called "Chlorophyll." An examination of a number of different specimens of Cantharides results in a general confirmation of this spectrum, but various differences are discoverable in the spectra afforded by various specimens, all of which, however, are comparable with the spectra given by "Chlorophyll" from the leaves of different plants, and there is, I think, no doubt, that whatever may be the cause of the general colour of the wing-cases, this specific green colour is due to the presence of "Chlorophyll" derived from such plants as the insect has fed upon during its life. For details of the mode of examination pursued, see "Pharmaceutical Journal," Vol. III., pp. 681—949.

H. POCKLINGTON.

PREPARATION AND MOUNTING.

Bleaching Leaves.—I am much interested in examining the leaf-tissues *during the process* of bleaching, noting in particular the various conditions of the cell-contents, starch, raphides, etc. And in many instances I prefer to mount such specimens at once (after well washing) in glycerine jelly.

Chlorinated soda is easily made by adding a saturated solution of common washing Soda to a saturated solution of Chloride of Lime, until all the chalk is thrown down; then filter, and keep in a dark place.

JOHN E. INGPEN.

One would primarily expect that the full action of Alcohol, Chlorine, etc., would be more rapid in delicate leaves than in thick ones (especially when of coriaceous texture), but this is not uniformly the case. I have roughly experimented with various kinds carefully selected, both whole and in pieces,—thick and thin,—succulent and coriaceous,—veined and reticulated; and I have noticed the degree and character of their permeability as individuals, but have not yet acquired sufficient information to warrant any general classification. I commend to the notice of those who care to take up this subject, the common *Arabis albida*, to be found in almost every garden; leaves of it bleach rapidly in Chloride of Lime alone, and give charming results. I could make half-a-dozen slides of Arabis leaf, all different in appearance, and vying with each other in beauty.

W. TEASDALE.

Bleaching Fluid for Insects.

Hydrochloric Acid	- - -	10 drops.
Chlorate of Potash	- - -	½ dr.
Water	- - - -	1 oz.

Soak the object in this fluid for a day or two; wash well.

W. SARGENT, Jun

To Mount in Glycerine.—Heat India Rubber till it become sticky, then dissolve it in Benzole, put a ring of this, both on cover and slide, then let it remain till tacky; place the object in glycerine, float it on if convenient, arrange it and place, and press down the cover, wash away spare glycerine, and run asphalte varnish or any other finish as preferred, and the slide is finished. The advantages are, the India Rubber sticks in spite of the glycerine, and is elastic, and so a great amount of trouble is saved.

J. G. P. VEREKER.

To Mount Plants in Glycerine and Water.—Add to the glycerine first a few drops of Carbolic acid to guard against fungoid growth, but do not use alcohol with the glycerine when the natural colour of the plant has to be preserved. Then make a mixture containing equal parts of carbolized glycerine and water; let fall a drop or two on the slide, place the object into it, and put on a covering-glass, which should not be cemented down: the water will evaporate in time, and more glycerine and water may be added, until the plant gets gradually filled with glycerine. After this comes what used to be a tedious work—the fastening down of the cover-glass. This may be easily accomplished by first placing a ring of gelatine round it, and to this any cement will adhere. The gelatine should be prepared by pouring cold water upon it, and allowing it to stand for 24 hours; afterwards pour off the water that remains unabsorbed, and heat the gelatine till it dissolves, adding a few drops of Carbolic acid. Each time before using the gelatine, place the bottle in a basin of hot water to make it fluid.

H. M. KLAASSEN.

Sections of Teeth to Grind.—I have been recommended to employ *ground glass*, using with it in the early stage fine ground pumicestone, which is especially needed for grinding rough shells, like those of Lobster or Crab. By soaking the jaw of a Mouse, Rat, Weasel, etc., in a solution of Balsam in Benzole, allowing it to become hard, and then grinding down as above, very beautiful sections showing the teeth *in situ* may be made.

H. E. FREEMAN.

To prevent the Growth of Mildew on Dry Mounts, it is useful to paint the specimen, and the interior of the cell, with a solution of Carbolic Acid, or Corrosive Sublimate in spirit, before mounting.

H. F. PARSONS.

Dr. Hunt's American Cement for Ringing-Slides.—An American correspondent has sent me the following recipe for making the cement, so effectually used by professional microscopists, and which some have regarded as a trade-secret:—

"Take some *Zinc White* as sold for painters' use, drain off the oil, and mix with *Canada Balsam* dissolved very thin with *Chloroform*. If it does not flow freely from the brush, add a little Turpentine. The mixture should be about the thickness of cream, and kept in a bottle with a glass cap. An old glass-capped spirit-lamp, fitted with a cork, in which the brush is fastened, is very convenient for holding it, and is always ready for use.

J. FORD.

Having sealed the slide with the above cement, paint on it with artists' oil-colours, thinned if necessary with Turpentine, and when dry, varnish it with very dilute Balsam, to give it a gloss.

F. J ALLEN.

Fatty Acids to prepare for the Microscope.—Boil up the fat or oil with solution of Caustic Soda or Potash (Liq. Sodæ or Liq. Potassæ) until the alkali is quite saturated and refuses to absorb any more fat. When it has cooled filter it and add dilute Sulphuric or Hydrochloric Acid (stirring and warming at the same time) until no more fatty acid separates. Boil for a second or two, then set aside to cool. When cold, the fatty acid will be found in a solid mass on the surface, and the liquid part may be thrown away.

It is well to boil the acid in *fresh* water to purify it; when, on cooling, it will be practically pure. N.B.—If the Liq. Potassæ or Sodæ is too strong, it will refuse to saponify.

To get Crystals, it is simply necessary to melt a small quantity on a slide, and spread it *very thin;* it crystallizes on cooling, and must be mounted "dry."

F. J. A.

Reports of Societies.

We shall be glad if Secretaries will send us Notices of the Meetings of their Societies. Short abstracts of Papers read, and principal Objects exhibited, will always be acceptable.

OUR ANNUAL MEETING.

THE Ninth Annual Meeting of this Society was held in the Duke's Salon, at the Holborn Restaurant on Thursday evening, October the 5th, Mr. G. D. Brown, M.R.C.S., F.L.S., President, in the chair, supported by Mr. Chas. Stewart, M.R.C.S., F.L.S., in the vice-chair, and the following Members and Friends. The Visitors' names are distinguished by an asterisk:—Rev. G. Bailey, Dr. G. D. Brown, Mr. W. P. Collins,* Dr. F. W. Cooper, Mr. F. C. Cox, Mr. T. Curties, Mr. H. E. Freeman,* Mr. J. W. Goodinge, Mr. A. Hammond, Mr. H. Hensoldt,* Mr. R. A. Hose,* Mr. J. E. Ingpen,* Mr. G. Looseley, Mr. A. Madge, Mr. F. Martin, Mr. J. Martin,* Mr. H. N. Maynard, Mr. S. H. Needham,* Dr. T. Partridge, Mr. C. N. Peal, Dr. Ralph * (Australia), Dr. C. Stewart,* Rev. E. T. Stubbs, Mr. W. Teasdale, Mr. A. Allen.

At the conclusion of the dinner, the PRESIDENT proposed the customary loyal toast, "The Queen," which was heartily responded to.

The Annual Report and Treasurer's Balance-Sheet, which had been distributed to the members, being taken as read, Mr. PEAL proposed, and Mr. COOPER seconded, a resolution, that the Report and Balance-Sheet be adopted, which was carried unanimously.

The following is a copy of the Report:—

THE COMMITTEE beg to present their 9th Annual Report, and in doing so have pleasure in congratulating the members of the "Postal Microscopical Society" on its continued and increasing success.

The ordinary Boxes which were in circulation at the date of the last Annual Meeting are still circulating, but will now be called in immediately. Considering the length of time that they have been

travelling, comparatively few accidents have happened to the slides. With the new issue of boxes it has been decided, in order to facilitate the production of notes and drawings, to send a larger Manuscript-book with each box. And at the suggestion of several members, the names of the circuits will be altered; as owing to the withdrawal of some members, and the addition of others, many of the names now employed do not represent the localities to which they belong. It has been proposed to name them alphabetically in future; and in order to distinguish the four boxes belonging to each circuit, a number will be affixed to each letter. Several additional Special Boxes have been put into circulation; amongst others may be mentioned one devoted to the Foraminifera by Mr. C. Elcock,—one on the *Linaria* by Mr. R. H. Moore,—and Diatoms by Dr. Partridge.

At the date of the last Sub-Committee Meeting, there were 170 members on the roll of the Society; of these 32 have been added during the last year; two have resigned, and it is with much regret that we have to record the loss of a third, Mr. H. W. M. Jackson, of Ealing, by death.

During the past 12 months seven Sub-Committee Meetings have been held; these have been fairly well attended, and the business done has been of a very satisfactory nature.

One act of negligence in the detention of boxes has just been detected and adjusted. It might have been avoided if each member would conscientiously follow the instructions given on page 5 of the last Annual Report, and which are here reproduced:—" The Hon. Secretary would again remind " all members that it is the duty of each one accurately to " chronicle in the Register-Book provided for that purpose, " the receipt and dispatch of all boxes; and whenever any " one finds that three weeks have elapsed without his receiv- " ing a box, he should at once intimate the fact to the Hon. " Secretary, who will then take steps to trace the defaulter; " and should the neglect prove serious, it will be laid before " the Local Sub-Committee at their next meeting." But in consequence of several members having kept no *accurate* record, and in some cases none whatever, of the receipt and dispatch of boxes, your Hon. Secretary had great difficulty in tracing the offender. Books properly ruled for the purpose

are supplied to each member free, and it is hoped that all those whose books are filled will at once apply for others.

The publication of the Notes of the Society is now an accomplished fact. The first part of the "Journal of the Postal Microscopical Society" was issued on March 25th, succeeded by others in June and September, and the fourth part, completing the first volume, will be ready about December 24th. The publication of this Journal has been mainly undertaken by your Hon. Secretary (under the advice of the Committee). In the Editorial department he has been assisted in no small degree by the Rev. J. H. Green (Chairman of the Local Sub-Committee), to whom are tendered herewith the best thanks of the members and subscribers generally.

The collation of the Notes is at present a more laborious work than it otherwise would be, if members would studiously avoid writing anything in the Note-books but what is of an instructive nature. It is found also that many Notes, which were instructive when accompanied by the slides, become comparatively valueless on being isolated from them; this points to the imperative necessity there is that all slides should be illustrated, as far as possible, by both pencil and pen.

With respect to the drawing of the plates, owing to the great expense attending high-class Lithographic work, the publisher has been induced to employ a local artist, and is pleased to note a marked improvement with each issue; it is confidently hoped that by the time the first part of Vol. II. is reached the execution of the plates will have become all that can be desired.

Your Hon. Secretary is desirous of waiting the issue of Part iv. before laying before you the financial result of the new enterprise; and meanwhile he would earnestly solicit your cordial help and co-operation. Especially is it desirable that each member should try and furnish original matter, written either by himself or some competent friend, suitable for the pages of the Journal, and calculated to increase its circulation and usefulness. And if each subscriber would also endeavour to obtain three or four others, the Journal would quickly become an undoubted success.

The following is a copy of the Balance Sheet :—

The Postal Microscopical Society in Account with the Treasurer.

	£	s.	d.		£	s.	d.
To Postages	36	3	4	By Balance brought forward	1	11	3
Letters, &c., surcharged ...		3	11	Annual Subscription, Entrance Fees, and Subscription for Circulating Journals ...	42	8	0
Journey to London, attending Annual Meeting	2	0	0	Deficit carried forward ...	15	16	9
Paper and other Stationery...	2	13	0				
Dinner Cards		3	6				
Christmas-Box to Postman ...		2	6				
Blackett's Bill	7	15	9				
New Boxes, Covers, &c. ...	5	0	0				
Journals	5	14	0				
	£59	16	0		£59	16	0

Audited this 7th day of September, 1882.

RICHD. H. MOORE.

Referring to the above extraordinary deficit, the Treasurer wishes to state that nearly £18 of last year's subscription still remains unpaid, which if paid would have shown as usual a balance in hand.

Mr. PEAL suggested that if there were any letters concerning the operations of the Society addressed to the Chairman, they should be read to the meeting.

The PRESIDENT replied that there was a letter from Colonel Basevi addressed to the Secretary, which he would ask him to read.

The SECRETARY then read the following letter :—

"Elm Lodge, Prestbury;
4th Oct., 1882.

"DEAR MR. ALLEN,—

Though unable to be present with you to-morrow, at the annual gathering of the P.M.S., I am anxious not to be totally unrepresented, and will ask you, therefore, to read this letter to the meeting. There are one or two points, I think, should be laid before this Annual Meeting for their consideration and vote. The first that I will mention is the circulation in our boxes of what are known as 'Stock Slides.' Since the early part of this year, no less than five boxes have contained the Proboscis of a Blow-Fly, and the note-books to each reported the opinions of members on the subject—one objecting, and the next remarking some special feature said to be better seen in that particular slide than in any previous one. Remarks such as these are, in my opinion, very objectionable, and take up room that might be filled

with really valuable information. This is especially necessary now that we are printing our Journal. I would therefore propose to the meeting that you, sir, or the Local Committee at Bath, be requested to return to any member who may circulate a very well-known, not to say common, object, his slide, with a polite letter, stating that as it has been so frequently in circulation it had better be exchanged, and I would only deviate from this rule when an object of the kind was accompanied by a drawing and such a description as would render it really instructive to those members of our Society who are students in that branch of natural history.

And now let me turn to another point—namely, the publication of our Journal. The three numbers that have been issued have far exceeded my expectations, and the last number is one that any Society might be proud to issue. I feel sure that if we can continue to secure Papers like those by Mr. Stokes and Mr. Charles Elcock, and that by Mr. Lovett on 'The Embryology of the Stalk-Eyed Crustacea,' the success of our experiment will be assured. I have only one suggestion to make, and that is that the services of a better draughtsman be secured. The plates in Nos. 1 and 2 are certainly inferior to the letterpress. I am aware that in this remark lays the main difficulty of the attempt to publish the contents of our Note-Books, as the expense of employing a good draughtsman is very heavy. Still, I think it is a subject worthy of consideration, and therefore take the liberty of bringing it before the meeting.

Hoping that you will have a successful evening, and regretting that my health prevents my joining you,

Believe me to be,

My dear Mr. Allen,

Yours very truly,

HENRY BASEVI."

The Secretary stated that he had also received letters from Mr. Searle, Mr. Bostock, and several others, regretting their inability to be present.

The CHAIRMAN suggested that the Secretary should be desired to write to Col. Basevi, regretting his absence and thanking him for his letter. With regard to the topics of his letter, he thought as to the Journal, that question should be left to the Journal Committee. And as to the other points, respecting slides, he considered it would be throwing a great deal too much upon the Secretary to request him to return slides not worth circulating. The question of suitability or non-suitability of slides must be left to the discretion of members. They might be told quietly

that their slides were not quite up to the mark; but sending back slides would not, in his opinion, be the nicest way of doing so.

Mr. WASHINGTON TEASDALE considered the report submitted to the meeting singularly satisfactory on the whole. This had been a year of very considerable progress, and the members should congratulate themselves on the improved position of the Society and its then satisfactory state. The circulation had not been so congested as in previous years. He certainly thought it a great improvement to have boxes in continual circulation. More slides had been circulated among *all* the members than ever before. It was most desirable to fill up the record-book regularly. He did not suppose many of the members would be able to fill up that book with a record of every slide, but he thought a smaller book, just to note the arrival and departure of each box, would be quite sufficient. He had himself kept such a record for several years before those books were issued, and since he had taken more interest in the affairs of the Society, he had indeed overlooked entering the slides, but had continued to keep a register of the receipt and despatch of the boxes. There was another matter, which perhaps he ought not to say anything about, as it would come on later—it was the marked progress in the Journal. This is the first year of its publication, and it certainly is at the present time becoming still more interesting and of greater importance with each issue, and he felt quite sure that, under the able management of its Editor, the indefatigable Hon. Secretary, it would before long become all that its promoters desired it—one of the leading and most useful microscopical Journals of the day Then there was the question of stock slides. There certainly were such slides, as for example the "Proboscis of the Blow-Fly," "Spicules of Gorgonia," and "Saws of the Saw-Fly." He suggested a sort of *Index expurgatorius* should be made of about two dozen of the most common slides. He did not think they would then hear anything more of stock slides. It was necessary to remember that many of their contributors were inexperienced in the use of the microscope. They purchased a microscope, and with it many of the stock slides, which to them were highly interesting, and with a sort of liberality in their ignorance they sent them round. At the same time, he held that they should not object to a slide just because a similar one had been circulated before. A certain object might be prepared in a particular way. Another member might send round the same object differently prepared to shew some special features, or the same features in a better manner. Another reason was that formerly only a small proportion of slides, certainly not more than half, were circulated through every circuit, or were ever seen by all

the members. Many of the slides circulated by their old members would be exceedingly interesting and valuable if they were sent round again.

The CHAIRMAN announced the result of the voting. Dr. Coombs was elected President-Elect and Dr. Partridge Vice-President for next year. He also said that though there could be no doubt on the next question, it was necessary that the Secretary should be formally re-elected. The Committee would also be re-elected for the ensuing year. Mr. Allen would, of course, be re-elected as Secretary and Treasurer, and he should be elected first.

Mr. CURTIES moved, in a short and very complimentary manner, that Mr. Allen should be asked to fill the office of Secretary and Treasurer for the ensuing year.

Dr. PARTRIDGE seconded the motion.

The CHAIRMAN, in putting the motion to the meeting, said Mr. Allen was undoubtedly the life and soul of the Society, and he could not think what they should do without him.

The motion was carried unanimously.

The SECRETARY thanked the Society for the honour they had done him. He had nothing to add to what he had said last year and in former years. It was a great pleasure to him to do the work of the Society. He felt that he could not be called a lazy man. It was not his nature, and he did not think he could fulfil the duties required of him if he were.

The members of the Committee to be re-elected were :—Col. H. Basevi, G. Dannatt, the Rev. J. H. Green, E. Lovett, H. N. Maynard, R. H. Moore, Geo. Norman, F. E. Robinson, the Rev. E. T. Stubbs; the Local Sub-Committee being the Rev. J. H. Green, the Rev. E. T. Stubbs, R. H. Moore, G. Norman, F. E. Robinson, and T. B. Silcock.

Mr. TEASDALE, in moving the re-election of the Committee and Sub-Committee, observed that the Society were much indebted to the Sub-Committee for their labours during the past year in reforming the working of the Society. As the Society was now so well constituted, he expressed a hope that many of the old members would be induced to rejoin the Society.

Dr. PARTRIDGE remarked that the Sub-Committee had devoted an immense amount, not only of time, but of careful thought, to the interests of the Society, and he had much pleasure in seconding the motion, which was put to the meeting and carried unanimously.

The CHAIRMAN stated that this concluded the business of the

evening, and it was now his duty to vacate the chair in favour of his successor, who, he felt sure, would be more an ornament to it than he had been.

Mr. HAMMOND, the President for the ensuing year, then took the chair.

Mr. CURTIES said it occurred to him that on the eve of Dr. Brown's departure from the chair, they should offer him their very cordial thanks for the work he had done during his term of office, and at the same time express their good wishes for the future. He trusted that, although resigning the presidency, he would continue to exert his influence to advance the interests of the Society.

Mr. MAYNARD, in seconding the motion, said they were all fully aware of the great service Dr. Brown had rendered to the Society.

The motion was put and carried by acclamation.

Dr. BROWN thanked the members very much for the kind way in which they had spoken of the small services he had been able to render during the year. The duties of the office had not been heavy, but had led him to take greater interest in the working and welfare of the Society. He was sure his interest would not diminish. He hoped the Postal Microscopical Society would continue to prosper.

The new President, ARTHUR HAMMOND, Esq., F.L.S., then proposed the toast of the evening, "Success to the Postal Microscopical Society," which was drunk with enthusiasm.

The PRESIDENT then delivered his address, the subject of which was "The Anatomy and Life-History of the Water-Flea, *Daphnia Pulex*," and was illustrated by a great number of large diagrams, specially prepared for the occasion, but owing to the advanced hour, he was compelled to pass over some interesting features. The address will be found *in extenso* in the current number of the Journal.

The Rev. E. T. STUBBS expressed great pleasure in listening to the President's interesting address. He remarked that there was great difficulty in getting the Daphnia into a suitable position for examination, as described by the President. It was usually seen lying upon its side; but it was necessary to get an endwise view of it, looking towards the rectum, front of the head, and back of the head. The examination of the Daphnia in those positions would add immensely to the knowledge of the animal. He found it very easy to get the Daphnia into other positions by placing them between two slips of wood, pieces of matches pared down, so as to fit inside a thin zoophyte trough. Two such parallel

slips of wood would include a number of Daphnia, which would be seen in various positions, and could be studied in a way not otherwise practicable. He could thus obtain a front view, and examine the small antennæ with their setæ, which were extremely interesting. By this means, also, a good view of other parts of the body could be obtained. He thought the suggestion would be found useful to the members. He begged to propose a vote of thanks to the President for his extremely interesting paper.

The PRESIDENT thanked the members for their kind attention.

The PRESIDENT then proposed "Success to Kindred Societies," mentioning especially the Royal Microscopical Society, the Microscopical Society of Victoria, Australia, and the Quekett Microscopical Club, officers of which Societies he was glad to see present as visitors. He coupled with the toast the names of Mr. Charles Stewart (Hon. Sec. of the Royal Microscopical Society), Dr. Ralph (President of the Victoria Society), and Mr. Ingpen (Hon. Sec. of the Quekett Club).

Mr. STEWART returned his best thanks for the kind manner in which the toast had been drunk. They all took the greatest interest in the Postal Microscopical Society and in any work connected with microscopic research. He was sure that all wished to do their best to further such meritorious efforts to popularise microscopy in outlying districts in the country.

Dr. RALPH acknowledged the graceful way in which mention had been made of the Society at the Antipodes, which he had the honour to represent as President on that occasion. He was gratified at having been present at that meeting. Though he was previously unaware of the existence of such a Society, yet, from what had transpired at the meeting, and from the publications which had been kindly put into his hands, he could see the value of such a Society. They had in the South a Society which was trying to work its way as a kind of affiliated Society with the Microscopical Societies in this country. They had also a few Naturalists' Clubs, but not one answering to the Postal Microscopical Society. He should certainly be happy to report its progress when he returned home, and he hoped to initiate others to undertake the formation of such a Society. He, in conclusion, again thanked them for the kind manner in which he had been received.

Mr. INGPEN said, as Dr. Stewart had replied on behalf of the Royal Microscopical Society, he would respond to their kindness more particularly on behalf of the Quekett Microscopical Club, with which he was more intimately connected. That Society had always been on the most friendly terms with the Postal Micros-

copical Society. It would give the members of the Quekett Club great pleasure to correspond with members of the Postal Society, especially the more distant ones, and offer them every assistance with regard to manipulation, processes, and other matters, in which they took especial interest. The value of microscopical pursuits in remote districts was fully recognized by their Club, and was also of considerable interest to the other higher bodies who were interested in microscopic work. He thanked them for their kind reception of the toast.

Mr. CURTIES said he had permission to propose the next toast, that of "The Journal," and it afforded him great pleasure to do so. It appeared to him that the publication of the Journal was likely to inspire new life into the Society, extending its influence far and wide. As a member, he warmly and heartily supported the Secretary's excellent idea in establishing the Journal. It gave them an opportunity of seeing the cream of their Note-Books, and it also enabled them to see the kind of work the Society continued to do. The Journal, to be a success, must have the support of members and their friends. All must take an interest in the work, and endeavour to increase its circulation. In conclusion, he thanked the Secretary for his courage in starting it, and for his continued zeal in the Society's welfare.

The SECRETARY, replying to the above remarks, said that the Rev. J. H. Green, of Bath, and himself had up to the present constituted themselves co-editors, and they have endeavoured to make the Journal in every respect as good as it could possibly be made for the money. Indeed, he was rather afraid that they had overstepped the mark. A man unused to publishing would very probably not receive so satisfactory an estimate from the printer as one more accustomed to the work would, and hence it is possible that the cost had not been sufficiently studied before issuing the first number. He felt, however, quite sure that, with the cordial co-operation of all the members and subscribers, success at no very distant date was certain. He asked them to do all they could to further this much-desired object—first, by contributing suitable matter for its pages and then by doubling the number of subscribers. The Editors will always be glad to consider any suggestions made by their friends likely to add to the efficiency of the Journal, and if the Secretaries of such Societies as do not publish their transactions would send the papers read at their meetings to our Journal, they would, if found suitable, and he thought there would be no doubt on that point, ensure a place in it. They would also be glad to receive papers from any of their members. He wished to thank Mr.

Curties for the very kind manner in which he had brought the matter forward.

Mr. MAYNARD said he felt much interest in the progress of the Society, having been connected with it from its commencement. He was particularly interested in seeing the Journal made a success. It was a step in the right direction. The Hon. Secretary had been considering for a long time in what way the Society could make use of the Notes in the Note-Books. He could not think of a better plan than selecting the cream of the Notes and publishing them in the Journal. The Secretary had already told them he had made it too cheap. That was the fault of their Society at the commencement, though he hardly liked to call it a fault. The Secretary desired to make the Journal as low-priced as possible. It was a good thing to work the Society cheaply, and he had gone on the same principle in producing the Journal. He hoped all would take an interest in it. If all did their best to increase the circulation, the desired end would be speedily attained.

At the close of the meeting, some interesting objects were exhibited, viz.—Daphnia (alive), by the President in illustration of his paper; also a number of large drawings explanatory of his paper, Mr. Curties kindly supplying a number of microscopes and lamps; various photographs of microscopic objects by Mr. Washington Teasdale; some lantern-slides by Dr. Partridge; slides of selected spicules, Polyzoa, etc., from weathered Carboniferous Limestone, by Mr. Needham, F.G.S. The late hour, however, to which the meeting had been protracted allowed but little time for the examination of the various objects.

BATH MICROSCOPICAL SOCIETY.

THE second general meeting of the Bath Microscopical Society was held on Tuesday, the 7th ult., at the Mineral Water Hospital, Dr. Hensley, the President, in the chair.—A paper was read by the Rev. E. T. Stubbs, M.A., on "Two Species of Arachnida," illustrated by some excellent drawings and slides. After sketching the history of the branches, classes, and sub-classes in the animal kingdom, the sub-class Arachnida was stated to consist of seven orders, all of which were graphically described, and from the two orders *Pycnogonidæ* and *Scorpionidæ* the specimens exhibited and treated of were obtained. From the former order a mounted specimen of *Pycnogonum littorale* was passed round the table and

explained, the creature having been obtained by Mr. Stubbs from the Brighton Aquarium, and found to be parasitic on the *Cetacea*. The order contains but one family, but several genera—some British, others exotic, but all exclusively marine. The specimen exhibited was furnished with eight legs surmounted with claws. Head tubular, in the form of a beak or proboscis. The abdomen rudimentary, with a very remarkable digestive cavity extending into the legs of the creature. These ramifications of the alimentary canal, however, appear to serve all the purposes of circulatory, respiratory, and chyliferous systems as in higher animals. Another slide was passed round the table from the order *Scorpionidæ*, and consisted of a fine Scorpion obtained from the shores of the Mediterranean. The body was of an elongated oval shape, covered with a horny integument. The abdomen united to the thorax, and consisting of 12 segments, five of the latter becoming narrower and forming the tail, which ends in a sharp curved sting. The poison which flows from this formidable weapon appears to be carried through two ducts to ten orifices near the point of the sting. The poison of the Scorpion is more or less venomous, depending on the age of the creature and the season of the year, and certainly upon the health or otherwise of the victim.—At the close of the paper, a discussion ensued upon the nature and effects of the poison.—Dr. Hensley tendered the thanks of the Society to Mr. Stubbs for introducing so interesting a subject.—Mr. Pumphrey exhibited a specimen of fresh-water Algæ (*Batrachospermum*), which had been introduced into a stream in his garden, and appeared to be well established.

Correspondence.

The Editors do not hold themselves responsible for the opinions or statements of their Correspondents.

BACILLARIA PARADOXA (p. 158).

To the Editor of "The Journal of the Postal Microscopical Society."

SIR,—

Many years ago I found this Diatom in the ditches intersecting swampy meadows on both sides of the river just above the town of Stafford, and communicated the fact to Professor Henfrey's "Botanical Gazette," 1851, p. 135.

I understand that recently borings have been made, not far from this locality, in search of a water-supply for the town, but the project was abandoned because the water proved to be too brackish for household use.

ROBT. C. DOUGLAS.

Manaton Rectory, Moretonhampstead,
Exeter; Oct. 17th, 1882.

To the Editor of "The Journal of the Postal Microscopical Society."

SIR,—

There seems little doubt that this diatom is more generally distributed than is supposed, for in addition to the locality mentioned by Mr. Douglas, it is noted by Mr. Davis, in "Practical Microscopy," as having been found attached to algæ taken from the canal at Birmingham.

Although probably not sweet, the canal-water ranging from Stoke-on-Trent to Birmingham can hardly be characterised as "brackish," although possibly that in the ditches round Stafford might be, as the neighbourhood is very low and marshy.

It is quite possible that, so far as the canal is concerned, the Diatom may have been imported; but, on the other hand, the fact of its being found in ditches round Stafford is against that view, and it is probable that, if carefully sought after, it would be frequently met with.

It can, however, no longer be correct to describe it, as it is at the present time in existing authorities, as a purely "marine" organism.

Stone. E. BOSTOCK.

FELSPAR AND OLIGOCLASE.

To the Editor of "The Journal of the Postal Microscopical Society."

SIR,—

In No. 1. of our Journal, the Rev. J. M. Mello, writing with regard to the Felspars, gives the formulæ wrong, as all the Oxygen is left out. I did not write before, as I thought it would have been corrected in the following number. They should be:—

No. 1.—$K_2\ O$, $Al_2\ O_3$, 6 $Si\ O_3$, and part of the $Al_2\ O_3$ replaced by $Fe_2\ O_3$, and $Mn_2\ O_3$, and the K O by $Na_2\ O$ or Ca O.

No. 2.—$Na_2\ O$, $Al_2\ O_3$, 6 $Si\ O_3$, Ca O, $K_2\ O$, or Mg O may replace the $Na_2\ O$.

And with the Oligoclase it should be Na_2 O replaced by Ca O.

Yours, etc.,
ARTHUR MADGE, F.C.S.

To the Editor of "The Journal of the Postal Microscopical Society."

DEAR SIR,—

I shall be glad to see expressions of opinion on the part of other members, about the lines round the plates. In all scientific works I have seen they are omitted.

Yours truly,
C. P. COOMBS.

[We do not think it desirable to enter into a discussion on this subject in the pages of the Journal, but if any of our subscribers have a decided preference for the plates with or without the border-lines and will write to us, we shall be glad to accede to the wishes of the majority. In some cases, the border-lines appear necessary; Plate 17 in the present part may be taken as an example.—*Editor.*]

AT the moment of going to press, we have received from Mr. E. Wade-Wilton, of Leeds, 7 or 8 sheets containing outline sketches and short descriptions of various specimens of Polyzoa and other aquatic organisms intended to accompany his weekly tubes.

His customers will doubtless find these sketches very useful, but we should have been glad to have seen that a little more care had been expended on their execution.

NOTICES TO CORRESPONDENTS.

All communications should be addressed to "Editor," care of Mr. A. Allen, 1, Cambridge Place, Bath. They must be accompanied by the name and address of the writers, but not necessarily for publication.

Several very interesting papers are in print, but are excluded from want of room. They will appear in our next.

SALE COLUMN.

Advertisements by members and subscribers are inserted here at the rate of SIXPENCE *for 20 words, and* THREEPENCE *for every additional 10 words or portion of 10.*

BOOKS RECEIVED.

Northern Microscopist, 22, 23, 24.
Quekett Journal, No. 2, New Series.
Natural History Journal and School Reporter, up to date.
The American Naturalist, Oct., Nov.
Natural History Notes, up to date.

List of Plates.

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[SUPPLEMENT.]

THE POSTAL MICROSCOPICAL SOCIETY.

RULES

AND

NAMES AND ADDRESSES

OF MEMBERS.

DECEMBER, 1882.

BATH: 1, CAMBRIDGE PLACE.
1882.

The Postal Microscopical Society.

Officers & Committee for the Session 1882-3.

President:

ARTHUR HAMMOND, F.L.S., 70, Finsbury Park Road, London.

President-Elect:

CAREY P. COOMBS, M.D., Castle Cary, Somerset.

Vice-President:

THOMAS PARTRIDGE, M.K.Q.C.P., M.R.C.S.E., Stroud, Gloucestershire.

Hon. Sec. and Treasurer:

ALFRED ALLEN, 1, Cambridge Place, Bath.

Committee:

ALFRED ARCHARD, Elm Place, Bath.
GEO. DANNATT, 5, The Circus, Greenwich.
REV. J. H. GREEN, 15, Prior Park Buildings, Bath.
EDWARD LOVETT, George Street, Croydon.
H. N. MAYNARD, M.I.C.E., 66, Wood Lane, Shepherd's Bush, W.
RICHARD H. MOORE, 13, Pulteney Gardens, Bath.
GEORGE NORMAN, M.R.C.S.E., 12, Brock Street, Bath.
WILLIAM PUMPHREY, The Cottage, Lyncombe Vale, Bath.
FRANK E. ROBINSON, Kynance, Weston, Bath.
REV. E. T. STUBBS, M.A., Charlcombe Rectory, Bath.

The Postal Microscopical Society.

A GREAT want has long been felt by those who take an interest in the Science of Microscopy, of a ready means of communication between microscopists living not only at a distance from each other, but also from London and other large towns where Microscopical Societies exist. It was to meet this want that towards the end of 1873 the "*Postal Micro-Cabinet Club*" was formed. At that date it was composed of thirty-six members; but having increased far beyond the expectations of its promoters, it was thought desirable in 1876 to revise the Rules, and at the same time to change its title to the "POSTAL MICROSCOPICAL SOCIETY."

The Society is divided into Circuits of twelve members each, whose names are arranged geographically; a box of slides is sent by the Hon. Secretary at fortnightly intervals to the member whose name stands first on the list, who must keep it three evenings only, and then send it on by post to the next member, and he to the following one. The member whose name stands last on the list returns the box to the Hon. Secretary, who forwards it to the first member of the next Circuit, and so on, until the objects have been seen by every member of the Society.

Each box of slides is invariably accompanied by one or more MS. books, in which the members are requested to make any remark of an instructive nature respecting the slides, or on any other branch of microscopy likely to prove interesting to the members generally. One most useful province of the Society should be to circulate information amongst its members, and to exchange hints respecting the most approved methods of preparing objects—*e.g.*, injecting, freezing, cutting hard and soft sections, both of animal and vegetable substances, decolorizing leaves and vegetable sections; staining in one, two, or more colours, mounting in various media; affixing cells securely to glass slips, etc. etc. Drawings, either plain or coloured, in illustration of slides contained in the box, or of new microscopic appliances, should be made on drawing-paper the size of a page of the MS. book and attached within the cover at the end of the same; such notes and drawings will be considered copyright, and exclusively the property of the Society, and may be removed from circulation by no person

but the Hon. Secretary, by whom they will be retained for future reference, or published if deemed expedient, by the Committee. Drawing-paper of suitable quality and size can be obtained on application to the Hon. Secretary.

It has been arranged to circulate several special series of slides. One devoted to Histological and Pathological subjects will circulate among the whole of the medical members, and will also be sent to all other members who desire to see them, if they will communicate their wish to the Hon. Secretary. Other series consisting of Diatomaceæ, Fungi and general Botanical slides, Foraminifera, and slides illustrating various other branches of Natural History are in circulation; these are sent through the entire circuit of the Society.

All members are invited to contribute a series of six or twelve slides to these special sections, but it must be distinctly understood that they are required, before doing so, to contribute their *quota* of slides to the regular boxes of the Society. Every slide, in each case, *must* be accompanied by descriptive notes, and *should* also be illustrated by a drawing.

Each member on admission to the Society is requested to send his *Carte-de-visite* to the Hon. Secretary, and as soon as sufficient portraits are collected, they will be grouped together and reproduced, and as this is for promoting a friendly feeling towards one another, each member, it is hoped, will take a copy of the same when published. Two of these groups have now been published: the first, which consists of sixty-four portraits, was printed in 1874, in Permanent Photography, by the *Autotype Fine Art Co.* The other, in which the portraits are arranged in a more pleasing manner, was printed in 1878 also in Permanent Photography by the *Woodbury Permanent Photographic Printing Co.* The two form very nice companion pictures. They are published by the Hon. Secretary. Several copies of the second group remain on hand, and may be had from him at 8/6 each, post free.

The President, at the termination of his year of office, will, if he deems it desirable, give a short address or written summary, recounting the proceedings of the Society, and the President-Elect, on taking the chair, will also read a paper referring to such Natural History and Microscopical subjects as he may deem conducive to the welfare and the furtherance of the objects of the Society.

Several gentlemen have presented a number of valuable slides to the Society. These will be kept by the Hon. Secretary for the us of the members, and will form the REFERENCE CABINET.

Any microscopist shall be eligible for membership who is able

to offer good slides for examination: and who will otherwise endeavour to contribute to the usefulness of the Society.

Several Journals specially interesting to microscopists are circulated amongst the members, the expense of the same being borne only by those to whom they are sent. The following are now in circulation:—*Journal of the Royal Microscopical Society*, *Quarterly Journal of Microscopical Science*, *Nature*, and the *American Monthly Microscopical Journal;* others will be added at the desire of the members.

RULES.

1.—That the Society be called "THE POSTAL MICROSCOPICAL SOCIETY," and that its purpose shall be the circulation, study, and discussion of microscopic objects; and the general advancement of microscopy and the Natural Sciences amongst its members.

2.—That application for membership must be made to the Hon. Secretary through a member of the Society, or other well-known microscopist, on the form provided for that purpose, and such application will in due course be submitted to the Committee for their approval. Every member on admission to the Society shall pay an Entrance-Fee of 5/- Ladies as well as gentlemen shall be eligible as members of the Society.

3.—That the Officers of the Society shall consist of a President, President-Elect, Vice-President, and Secretary, the latter acting as Treasurer, to be elected annually by the members at large; and of a Committee of Management, composed of six or more members, elected at the Annual Meeting; the President, President-Elect, Vice-President, and Secretary, being *ex-officio* members of the Committee, any six of whom shall form a quorum.

4.—That a Local Sub-Committee be formed of some of the members residing in Bath, who shall meet at monthly intervals, and that all acts of detention of boxes, damage to, or non-circulation of slides, or any other acts of irregularity, be laid before such Sub-Committee, which shall have full power from the General Committee to act in such a manner as in their opinion the occasion may require.

5.—The Annual Meeting of the Society shall be held in London, as near as practicable to the 1st of October in each year,

to receive the Report of the Committee for the past year; to elect Officers and Committee for the coming year; and to transact any other necessary business of the Society.

6.—That the Hon. Secretary shall arrange the Circuits, so that each shall consist of twelve members. Each member receiving a box of slides may keep it three evenings only, Sundays not being reckoned, after which he shall send it packed, as directed in Rule 15, to the next name on the list, having first fully filled up the Way-bill accompanying it. If, however, such box is described as being on its FIRST CIRCUIT, each receiver must add a slide, removing at the same time his own therein contained, and every slide so added must be mounted on the ordinary 3 in. by 1 in. slip, which may be either of glass (ground-edged or papered), wood, or cardboard.

7.—That the books which accompany the boxes shall be used for recording notes and memoranda of interest on the slides circulated. Members on placing a slide in the box are desired to give all the information in their power on the object shown, accompanying it with the necessary illustrative drawings. These will be published as means permit. Other members who can in any way add to a knowledge of the subject are requested to do so. And as valuable information may frequently be elicited by questions relating thereto, such may properly find place in the books. Any other information of general interest to the microscopist may also be written in the Note-Books.

8.—That no slide shall be removed from the box by any person but the owner, and then only after it has completed the round of the Society, unless by special request or by permission of the Committee.

9.—That the member whose name stands last on the list shall in due course send the box and all slides, MSS., and drawings belonging thereto, to the Hon. Secretary, who will then send it on to the next circuit, and so on, until it has been seen by all the members of the Society.

10.—That the Annual Subscription be 5/-, payable in advance on 1st October, but that any member elected in August or September be exempt from such subscription until the following October.

11.—That the Entrance-Money and Annual Subscription shall be paid to the Treasurer for the time being, the amount to form a fund for the purchase of the necessary boxes, and for the payment of postages, with other expenses to which he may be put. It

shall be the duty of the Treasurer at the end of each year to render to the Committee an account of his receipts and disbursements on behalf of the Society.

12.—That any member who shall by accident or otherwise break or damage any slide whilst it is under his care, or cause such to be broken by bad packing, before it is received by the next member, will be considered liable for the same; the value of such slide to be assessed by the Committee.

13.—That any member who receives the box with its contents damaged, must at once inform the Hon. Secretary of the fact, and enclose to him, at the same time, the broken or damaged slide or slides, which should always be packed in a WOODEN BOX.

14.—The MS. book or books, if they make the parcel over 12 oz., must not be enclosed with the box, but sent by book-post as a separate package. Both box and books must be sent by the same post, and any member who receives either one whole day before the other, must write at once to the sender and to the Hon. Secretary, who will take immediate steps to recover the same.

15.—To secure safety in transit, no greater number of slides than there are spaces allotted to receive them may be placed in the box, which must be packed in the black wrapper. The address should be written on a loose label tied to one end of the box, and sufficient stamps to prepay postage placed on the label (not on the box), special care being taken that the package does not exceed 12 oz. in weight. N.B.—The package should never be wrapped in paper.

16.—That any member who may be leaving home for three days or more, shall write and inform the Hon. Secretary, who will then arrange that no boxes shall be sent to him during his absence.

17.—That no member may circulate any but *good* slides, and each slide must bear the owner's name and address; it is also wished, though not absolutely insisted on, that it be his own mounting.

18.—That a register-book be supplied to each member, in which to enter the name, date of receipt and despatch, and contents of each box as it comes to hand. New books may at any time be had on application to the Hon. Secretary.

19.—That everything written in the MS. books, and all draw-

ings accompanying the same, shall be considered copyright, and exclusively the property of the Society, and shall only be removed by the Hon. Secretary.

20.—The Secretary shall, when required, lend six or a lesser number of slides from the Reference Cabinet, with all notes relating thereto, to any member wishing for them. When applying for such slides, the borrower must send a box and three penny postage-stamps to prepay postage, and must return the slides, post-paid, within a fortnight.

21.—If MS. notes be appended to any of the slides presented to the Reference Cabinet, they should be written on separate sheets of paper of uniform size, which may be obtained of the Secretary on application. These notes will always be lent with the slides.

22.—In the event of any member negligently or wilfully detaining a box beyond the proper time; or if any disagreement arise between two or more members, or any member make use of rude or unpolite remarks, such matters shall be referred to the Committee, whose decision in the case shall be final.

List of Members,

Showing the date of entrance of new members and the circuits in which they are placed.

1882.

Ex-Presidents :—

1873-4; 1874-5:
ALFRED ATKINSON, C.E., BRIGG.
1875-6; 1876-7; 1877-8; 1878-9:
TUFFEN WEST, F.L.S., F.R.M.S., &c., FRENSHAM.

1879-80:
H. FRANKLIN PARSONS, M.D., F.G.S., WHITEHALL, LONDON, S.W.

1880-1:
WASHINGTON TEASDALE, F.R.M.S., HEADINGLEY, LEEDS.

1881-2:
GEO. D. BROWN, M.R.C.S.E., F.L.S., HENLEY VILLA, EALING, W.

President :—1882-3:
ARTHUR HAMMOND, F.L.S., 70, FINSBURY PARK ROAD, HORNSEY, LONDON, N.

ALLEN Alfred, Hon. Secretary and Treasurer, 1, Cambridge Place, Bath.

(*h*) ANGOVE E. S., M.R.C.S., &c., Ivy House, Camborne, Cornwall.

Feb., 1881.—(*f*) ANGOVE W. T., M.R.C.S., &c., Mildenhall, Suffolk.

June, 1882.—(*h*) APPLETON W. M., 22, Regent Street, Clifton, Bristol.

(*i*) ARCHARD A., 15, Bath Street, and 8, Elm Place, Bath.

ATKINSON A., C.E., Ex-President P.M.S., Brigg.

June, 1882.—(*b*) ATKINSON W., 55, Bold Street, Liverpool.

Oct., 1881.—(*g*) Baddeley Col., 12, Pittville Villas, Cheltenham.
March, 1882.—(*l*) Bailey Rev. G., 1, South Vale, Central Hill, Upper Norwood, S.E.
April, 1881.—(*m*) Barrett Sidney R., C.E., 23, Stainsby Road, Poplar, E.
(*g*) Basevi Col. H., Elm Lodge, Prestbury, Cheltenham.
(*f*) Bellingham B., 205, Wolverhampton Street, Dudley.
(*b*) Booth P. L., M.R.C.S., 11, Hartington Street, Barrow-in-Furness.
(*b*) Bostock E., F.R.M.S., The Radfords, Stone, Staffordshire.
Feb., 1881.—(*e*) Bradshaw Isaac, 28, Breadabane Place, Great Victoria Street, Belfast, Ireland.
(*k*) Brown George D., M.R.C.S.E., F.L.S., &c., Ex-President P.M.S., Henley Villa, Ealing, W.
June, 1882.—(*i*) Bryant Miss B., 2, Duke Street, Bath.
Nov., 1881.—(*m*) Burbidge W. H., Stanley House, Alleyne Park, West Dulwich.
March, 1882.—(*b*) Bygott Robt., F.R.M.S., Sandbach.

(*c*) Cheesman Wm. Norwood, Hon. Sec. Selby Naturalists' Society, The Crescent, Selby.
(*a*) Christie James C., Old Cathcart, near Glasgow, Scotland.
(*f*) Clover Ernest, Springfield Lodge, Sudbury, Suffolk.
Cole Arthur C., F.R.M.S., St. Domingo House, Oxford Gardens, Notting Hill, London, W.
Dec., 1880.—(*b*) Cooke John H., F.R.M.S., Winsford, Cheshire.
(*h*) Coombs Carey Pearce, M.D. Lond., President-Elect P.M.S., Castle Cary, Somerset.
(*m*) Cooper Frank W., L.R.C.S.E., Gainsborough House, Leytonstone, Essex, E.
(*a*) Cooper William, 69, West Percy Street, North Shields.
April, 1881.—(*i*) Corser Rev. R. K., M.A., 12, Beaufort East, Bath.
Nov., 1882.—(*k*) Cotton Edwin, Rose Cottage, Cowley Road, Uxbridge.
(*d*) Cowen Mrs. A., 9, Rope Walk, Nottingham.
Nov., 1882.—(*k*) Cox Fredk. A., M.R.C.S.E., 3, Dean Street, Park Lane, London, W.

Dec., 1880.—(*k*) Cox F. C., 111, Blenheim Crescent, Kensington Park, W.

June, 1881.—(*g*) Cozens Miss M., 17, Royal Crescent, Cheltenham.

Dec., 1880.—(*a*) Crewdson Rev. Geo., M.A., St. George's Vicarage, Kendal.

Crisp Frank, LL.B., B.A., Vice-Pres. and Treas. L.S., Sec. R.M.S., 6, Old Jewry, London, E.C.

Oct., 1882.—(*d*) Crowther G. H., D.D.S., L.D.S., R.C.S., M.O.S., Bond Street, St. John's, Wakefield.

Curties Thomas, F.R.M.S., 244, High Holborn, London, W.

(*n*) Daniel W. Clement, M.D., M.R.C.S.E., Church Street, Epsom.

(*l*) Dannatt George, 5, The Circus, Greenwich, S.E.

Sep., 1882.—(*e*) Davis Henry, 29, Linen Hall Street, Belfast, Ireland.

(*k*) Dibdin W. J., F.C.S., F.I.C., 18, Union Road, Tufnell Park, London, N.

(*a*) Dunlop M. F., Glenview, Finnart Road, and 2, Church Place, Greenock, Scotland.

(*e*) Elcock Charles, 10, Dunluce Street, Belfast, Ireland.

Oct., 1882.—(*l*) Epps Hahnemann, A.K.C. Lond., 9, Eliot Bank, Sydenham Hill, S.E.

May, 1881.—(*l*) Epps James, Junr., The Homestead, South Park Hill Road, Croydon.

June, 1882.—(*l*) Everett Miss A., 1, Knight's Hill Terrace, Lower Norwood, S.E.

Sep., 1882.—(*n*) Farhall Maurice, 3, St. John's Road, Dover.

Feb., 1881.—(*f*) Fenton Mark, M.D., Grey Friar's Green, Coventry.

Field J. J., North Lodge, New Barnet, Herts.

April, 1881.—(*k*) Fisher Jos. Wm., Apsley Villa, The Grove, Ealing, W.

(*g*) Fisher W. H. C., Rowcroft, Stroud, Gloucestershire.

Fitch Frederick, F.R.G.S., F.R.M.S., Hadleigh House, Highbury New Park, London, N

(*g*) Fluck H. B., 4, Northgate Street, Gloucester.
(*f*) Ford John, The Uplands, Tettenhall, Wolverhampton.
Feb., 1881.—(*n*) Frampton Capt., Porchester, Hants.
(*h*) Freame Robert S., The Chantry, Gillingham, Dorset.

(*d*) George C. F., M.R.C.S.E., L.M., L.S.A., &c., Belle Vue House, Kirton-in-Lindsey, Hull.
(*g*) Giller W. T., County of Gloucester Bank, Gloucester.
Dec., 1882.—(*e*) Glascott Miss L. S., Alderton, New Ross, Ireland.
Sep., 1882.—(*m*) Gonçalves-Guimarães Dr. D. Antonio Josè, Prof. Mineralogy and Geology, University Coimbra, Portugal.
Goodinge James Wallinger, F.R.M.S., F.R.G.S., 18, Aldersgate Street, London, E.C.
June, 1882.—(*a*) Goodwin William, 3, Lynedock Street, Glasgow, Scotland.
Sep., 1882.—(*c*) Gough Thos., B.Sc., F.C.S., 20, De Grey Street, York.
(*i*) Green Rev. J. H., 15, Prior Park Buildings, Bath.
Oct., 1882.—(*k*) Greville H. Leicester, F.I.C., F.C.S., 4, Moreland Terrace, Lambton Road, Hornsey Rise, London, N.

(*k*) Haigh William, Tempsford Villa, Ealing, W.
June, 1881.—(*l*) Hall Robt., Garth Villa, Clyde Road, Croydon.
Feb., 1882.—(*l*) Halsey Rev. J., Woodlands, Thicket Road, Anerley, S.E.
(*k*) Hammond Arthur, F.L.S., President P.M.S., 70, Finsbury Park Road, Hornsey, London, N.
(*c*) Harrison J. S., F.R.M.S., Wellington Villa, Norton, Malton, Yorksh.
Sep., 1882.—(*m*) Henriques Dr. Julio A., Prof. Botany University Coimbra, Portugal.
(*f*) Henty Miss M. A., Nazing Park, Waltham Cross, Herts.
(*g*) Hepworth Geo. A., M.R.C.S.E., &c., 4, Clarence Street, Gloucester.

(*i*) HIPPISLEY Miss, Ston Easton Park, and (during the winter) 57, Great Pulteney Street, Bath.
(*h*) HOLDSWORTH S. R., M.D., Southridge House, Hindon, Wilts.
Oct., 1882.—(*b*) HOGG John Alexander, Serpentine Lodge, Buxton.
(*d*) HOLMES C. D., West Parade, Anlaby Road, Hull.
April, 1881.—(*n*) HOPE Miss B., Mead Vale, Red Hill, Surrey.
(*n*) HORSLEY Col., R.E., St. Stephen's Lodge, Canterbury.
(*a*) HOWORTH Capt., Felixstow, Ipswich, and Braemar, Aberdeenshire, Scotland.
(*h*) HUDSON R. S., M.D., Trewirgie Villa, Redruth, Cornwall.
(*c*) HUNTER E., F.C.S., Tillage Works, Goole.

(*d*) JAMIESON James, 95, Constable Street, Hull.
(*i*) JARRETT Miss E. E., Camerton Court, Bath.
Dec., 1882.—(*i*) JOLLY Herbert, Stow Villa, Oldfield Road, Bath.
Mar., 1882.—(*m*) JORGE Dr. Ricardo, Oporto, Portugal.

Dec., 1882.—(*f*) KEMPSON A., Pres. Micro. Sect., Northampton Nat. His. Soc., Parade, Northampton.
(*l*) KLAASSEN H. M., F.G.S., Northside, Chepstow Road, Croydon.

April, 1881.—(*l*) LEMMON Mrs. J. A., Stanley House, Park Hill Road, Croydon.
Sep., 1882.—(*e*) LETT Rev. H. W., M.A., T.C.D., Ardmore Glebe, Lurgan, Ireland.
(*h*) LOCOCK Rev. W., 13, Alexandra Road, Clifton, Bristol.
(*m*) LOOSELY George, Toxteth Villa, 68, Wood Lane, Shepherd's Bush, London, W.
(*l*) LOVETT Edward, 55, George Street, Croydon.
(*a*) LYALL Thos., 95, High Street, Montrose, Scotland.

(*l*) MADGE Arthur, East Greenwich.
(*c*) MALCOMSON S. M., M.D., Union Infirmary, Lisburn Road, Belfast, Ireland.
Nov., 1882.—(*k*) MARDON Daniel A., 129, High St., Uxbridge.

(*n*) MARTIN Francis, R.N., Shrub Cottage, Fairfield Road, Old Charlton, Kent.

Oct., 1882.—(*c*) MAYNARD H. Ll., 15, Barlow Terrace, Keighley, Yorks.

(*m*) MAYNARD Henry N., Mem. Inst. C.E., 66, Wood Lane, Shepherd's Bush, W., and 7, Westminster Chambers, London, S.W.

(*f*) MOORE Milner, M.D., Hales Street, Coventry.

(*e*) MCKEE W. S., Mill Street, Belfast, Ireland.

(*k*) MCKENZIE J., M.S.T.E. & E., Warden Villa, Uxbridge Road, Ealing, W.

(*d*) MEASURES J. W., M.R.C.S.E., Long Sutton, Lincolnshire.

(*e*) MILLS S., A.B., L.R.C.P., L.R.C.S., &c., Lake View, Fourmile House, Newry, Co. Down, Ireland.

(*c*) MILNE Geo. A., F.C.S., Welham Villa, Norton, Malton.

April, 1882.—(*a*) MILROY Anthony, L.R.C.P., Kilwinning, Ayrshire, Scotland.

(*g*) MOORE Richard H., Hon. Sec. Bath Microscopical Society, 13, Pulteney Gardens, Bath.

Aug., 1881.—(*c*) MORRIS Rev. A. B., 77, Devonshire Street, Keighley, Yorks.

MORRISS F. W., Silver Street, Boston, Lincolnshire.

Feb., 1882.—(*h*) MUNDY G. B., The Wilts and Dorset Bank, Warminster.

Nov., 1881.—(*b*) NARRAMORE Wm., 5, Geneva Road, Elm Park, Liverpool.

(*n*) NEALDS J. G. M., 58, High Street, Guildford.

(*d*) NEWMAN W., M.D. Lond., F.R.C.S., Barn Hill House, Stamford.

(*i*) NORMAN G., M.R.C.S.E., 12, Brock St., Bath.

(*d*) OAKLEY J., M.R.C.S.E., &c., Holly House, Halifax.

April, 1882.—(*e*) O'HALLORAN J., Inland Revenue Laboratory, Custom House, Belfast, Ireland.

(*n*) PAGE W. Irving, F.R.G.S., M.R.C.S. Wimbledon Common, Surrey.

(*l*) PARSONS H. F., M.D. Lond., F.G.S., Past President P.M.S., 13, Whitworth Road, South Norwood, S.E., and Local Government Board, Whitehall, London, S.W.

PARSONS S. G., 54, Bedford Gardens, Campden Hill, Kensington, W., and 91, Great Tower Street, E.C.

(*g*) PARTRIDGE T., M.K.Q.C.P., M.R.C.S.E., L.S.A., Vice-President P.M.S., Bowbridge House, Stroud, Gloucestershire.

(*c*) PEACH Robert, North Park Road, Harrogate.

(*k*) PEAL C. N., F.R.M.S., Fernhurst, Mattock Lane, Ealing, W.

(*c*) POCKLINGTON H., F.R.M.S., Barden Grove, Armley, and 20, Park Row, Leeds.

(*n*) PREECE W. H., F.R.S., Mem. Inst. C.E., F.R.M.S., Wimbledon Common, Surrey.

(*g*) PRIESTLAY J. E., B.A., Abbey House School, Tewkesbury.

(*f*) PRIOR C. E., M.D., St. Peter's, Bedford.

Oct., 1882.—(*g*) PROTHERO D. G., M.D., Enderly, Great Malvern.

Nov., 1881.—(*i*) PUMPHREY W., Vice-Pres. Bath Microscopical Society, The Cottage, Lyncombe Vale, Bath.

Sep., 1882.—(*e*) PURDON Dr. R., College Square, East, Belfast, Ireland.

May, 1881.—(*b*) READ W. H., Kelvin Grove, Prince's Park, Liverpool.

Sept., 1882.—(*m*) REBELLO-VALENTE Alvaro, Coimbra, Portugal.

(*h*) RICH W., Jun., Heanton Terrace, Redruth, Cornwall.

(*d*) RIDPATH D., M.D., Gt. Driffield, Yorks.

(*i*) ROBINSON F. E., 3, Henrietta Street, and Kynance, Newbridge Road, Bath.

(*d*) ROBINSON G. H., 11, Westgate, and 52, Spring Street, Huddersfield.

(*d*) ROGERS J., F.R.M.S., 4, Tennyson Street, Nottingham.

(*c*) ROOKLEDGE J., F.R.M.S., York Union Banking Co., Easingwold.

(*h*) SARJANT T. B., 10, Westfield Park, Redland, Bristol.
(*f*) SEARLE A. H., Church Street, Lutterworth.
Nov., 1881.—(*i*) SILCOCK T. B., B.Sc., Coldstream Villa, Greenway Lane, and 14, Abbey Churchyard, Bath.
(*h*) SMITH C. Vance, 3, Parade, Carmarthen.
Feb., 1882.—(*a*) SMITH J., Stobs, Kilwinning, Ayrshire, Scotland.
(*b*) SMITH Richard, Stoke-on-Trent.
Oct., 1882.—(*k*) SNELL J. Saxon, 86, Belsize Road, St. John's Wood, N.W.
(*d*) STEAD J. J., Albert Cottage, Heckmondwike.
June, 1881.—(*a*) STEEL T., Glentower, Wood Street, Greenock, N.B., and Condong, Tweed River, Brisbane, Queensland.
Sep., 1882.—(*f*) STEWARD J. W., 42, High Street, Bridgnorth.
(*m*) STOKES A. W., F.C.S., Analytical Laboratory, Vestry Hall, Harrow Road, London, W.
(*i*) STUBBS Rev. E. T., M.A., Ex-President Bath Microscopical Society, Charlcombe Rectory, and Sion Hill Place, Bath.
April, 1882.—(*d*) SUTCLIFFE F., Ash Street, Bacup, Lancashire.

(*m*) TAIT W. C., C.M.Z.S., Oporto, Portugal.
(*c*) TEASDALE W., F.R.M.S., Ex-President P.M.S., Rosehurst, Headingley, Leeds.
Oct., 1882.—(*e*) TURTLE Fredk. L., Aghalee, Lurgan, Ireland.
(*e*) TURTLE J. G., 1, Cambridge Terrace, Ormean Road, Belfast, Ireland.
(*n*) TUTTE E., Fareham, Hants.

(*n*) VEREKER Hon. J. G. P., Captain 4th Brigade South Irish Division, R.A., 1, Portman Square, and Union Club, Trafalgar Square, London, and East Cowes Castle, Isle of Wight.

Oct., 1882.—(*e*) WADDELL Rev. C. Herbert, B.A., The Rectory, Warren Point, Co. Down, Ireland.
(*b*) WARD Mrs. J. Clifton, St. Helen's, Cockermouth.
(*g*) WATKINS C. J., King's Mill House, Painswick, Gloucestershire.

Oct., 1881.—(*e*) WATSON T., 7, East Wall, Londonderry, Ireland.

(*h*) WATSON T. E., F.R.M.S., St. Mary's Lodge, Newport, Mon.

Sep., 1882.—(*f*) WATTS Rev. G. E., Kensworth Vicarage, Dunstable, Beds.

WHEELER D., M.R.C.S.E., L.S.A., F.O.S., &c., Chelmsford.

Nov., 1882.—(*n*) WHITE Barrington, M.R.C.S.E., L.Sa., Frant, Sussex.

(*f*) WHITEFOOT T., jun., 36, High Street, Bridgnorth.

Dec., 1880.—(*k*) WILLIAMS A. R., 19, Pemberton Road, Upper Holloway, N.

Sep., 1882.—(*b*) WILLIAMS H. H., 1, Shrewsbury Road, North, Claughton, Birkenhead.

Oct., 1881.—(*i*) WILSON J. H., Woodville, Lansdown, Bath.

Nov., 1882.—(*h*) WOODD H. T., M.R.C.S.E., L.Sa., Calstock, Cornwall.

(*h*) WOODS T., Gillingham, Dorset.

(*n*) WOOLLCOMBE W. G., B.A., F.L.S., Brighton College, Brighton, and Cathedral Close, Exeter.

May, 1881.—(*f*) WRIGHT John, F.R.M.S., The Lodge, Whitton, Suffolk.

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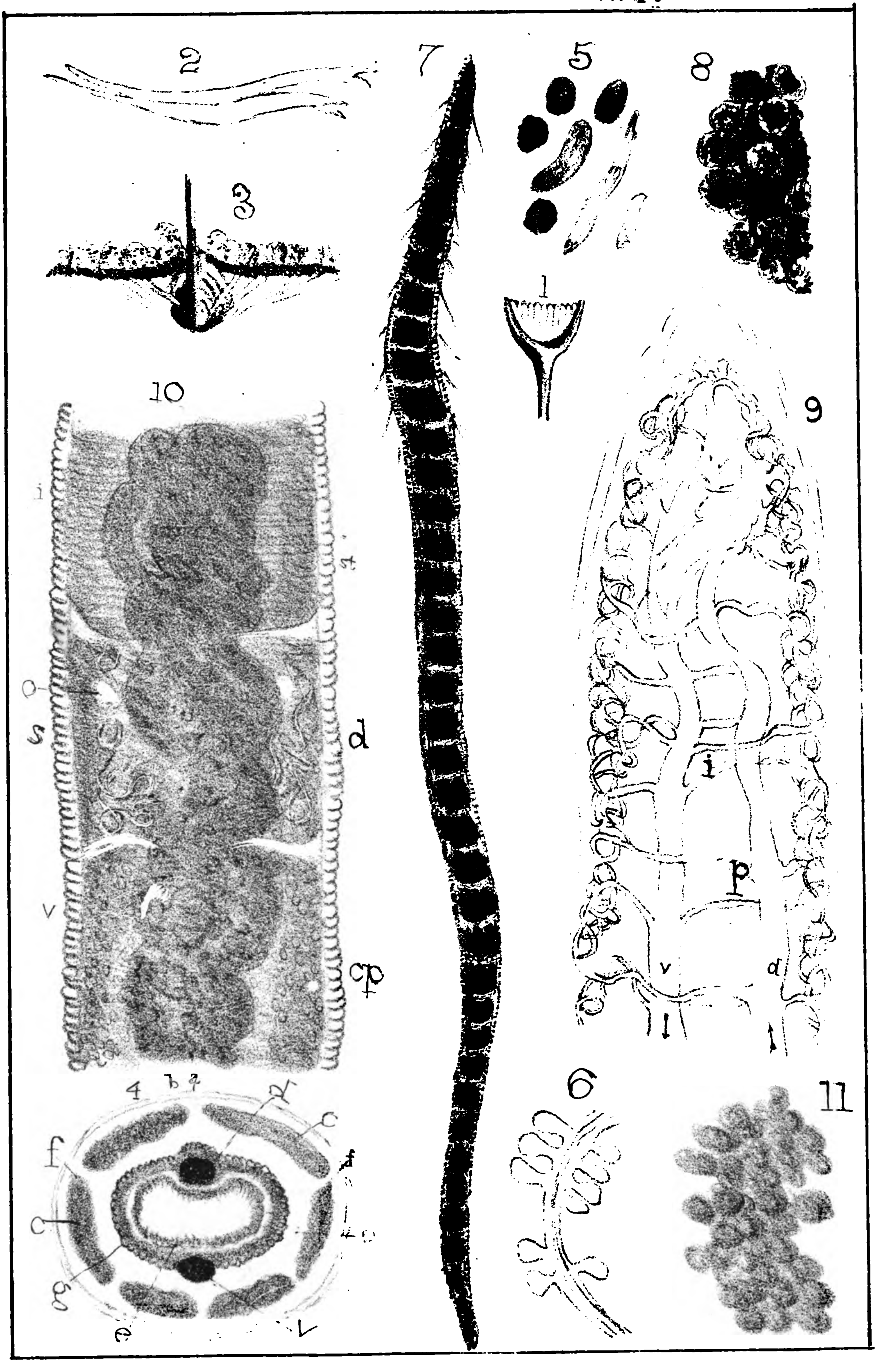

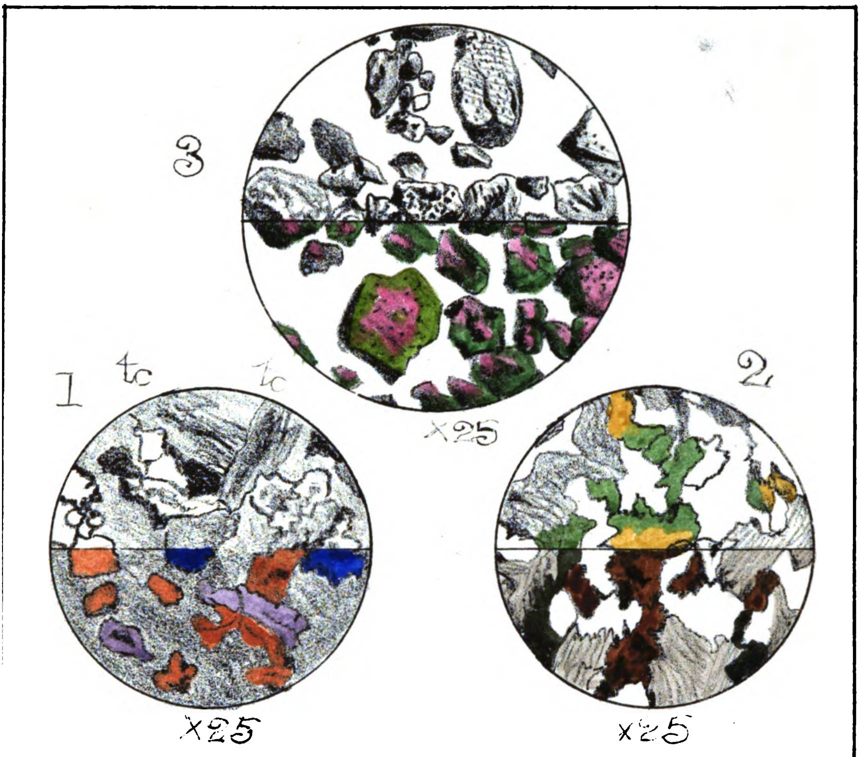
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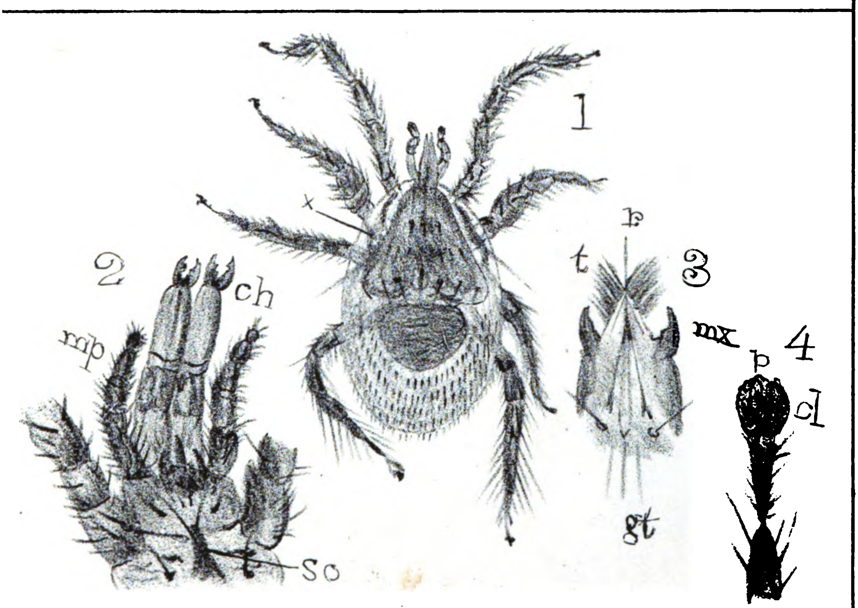
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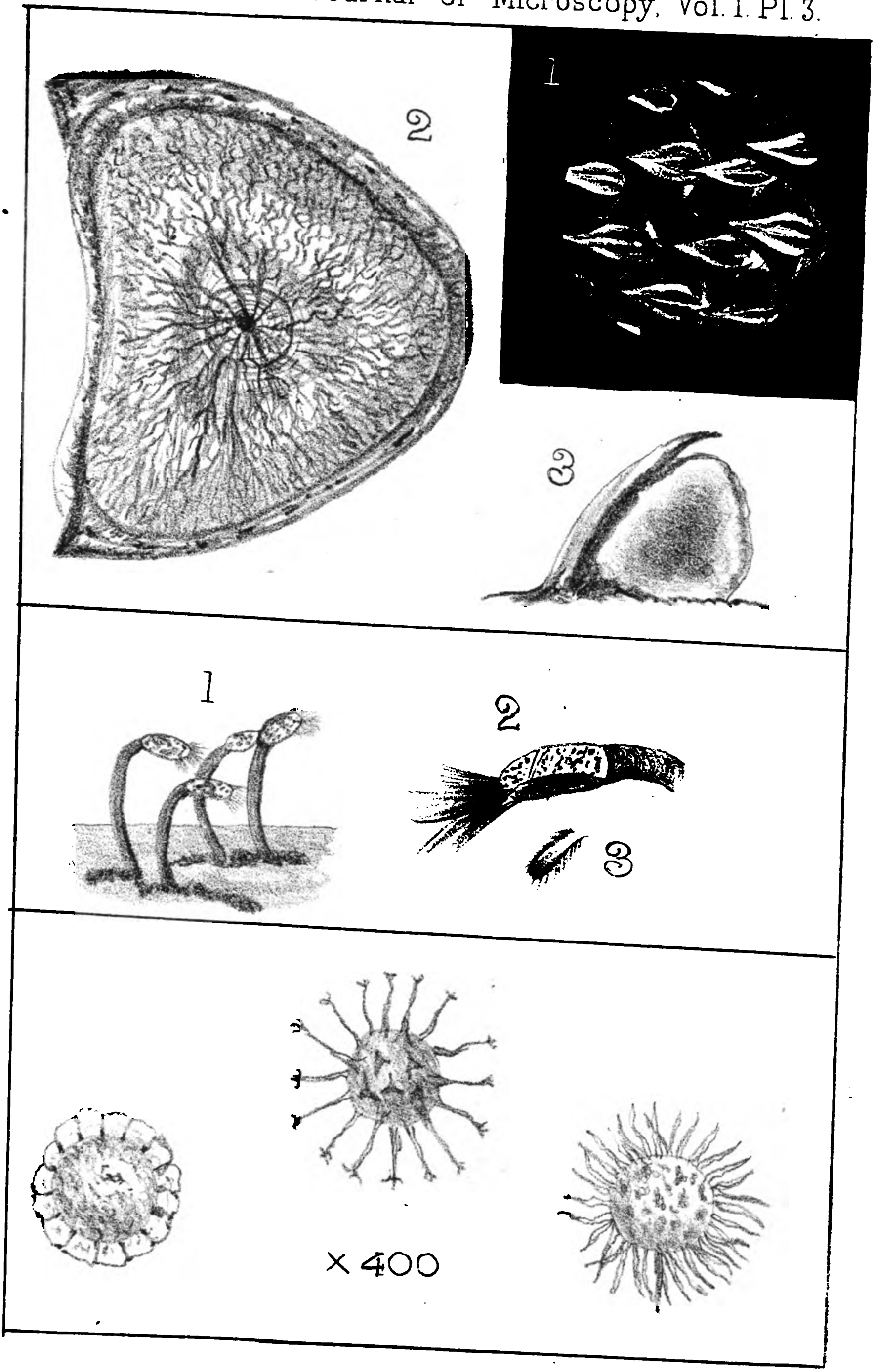
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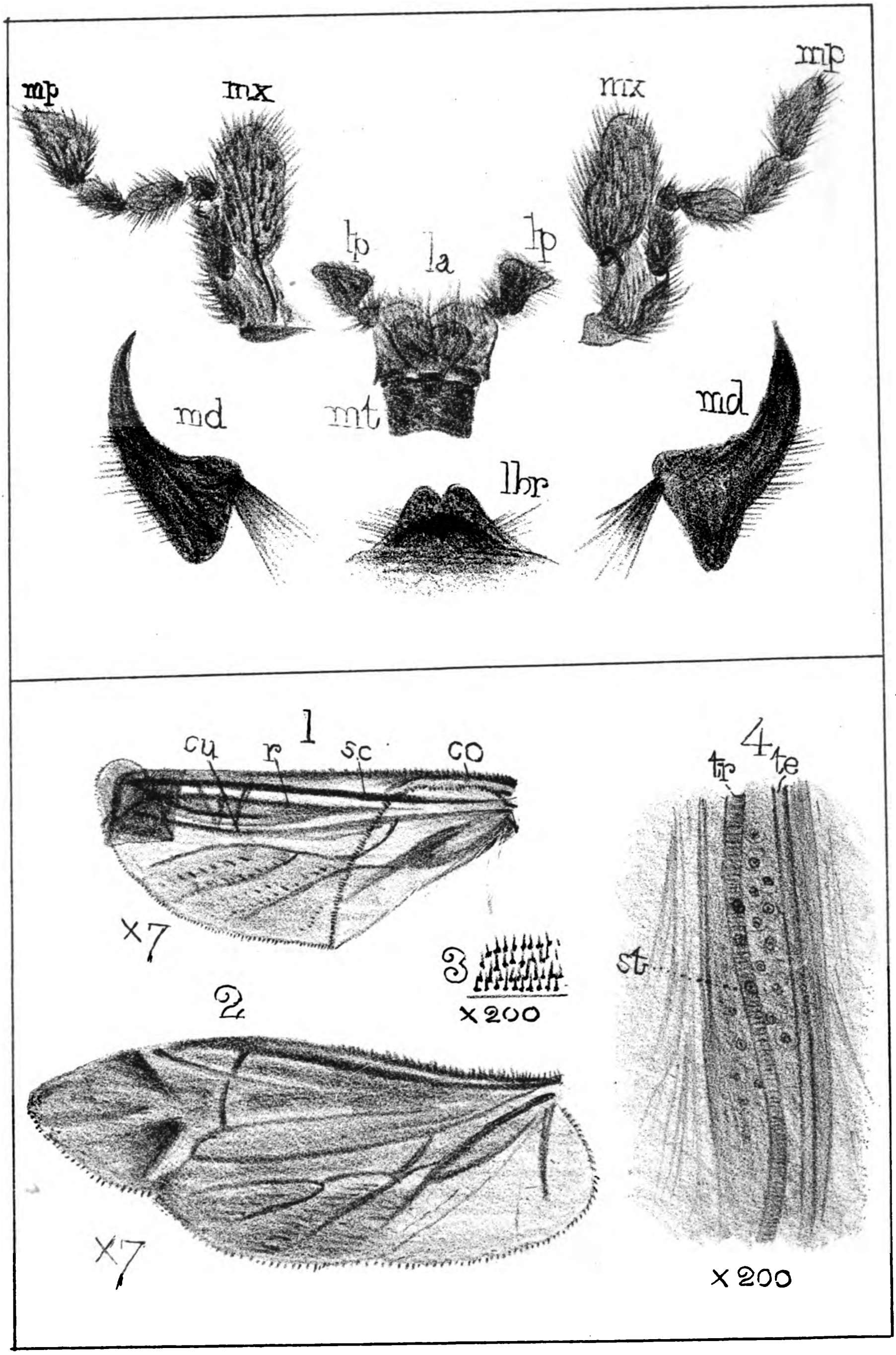
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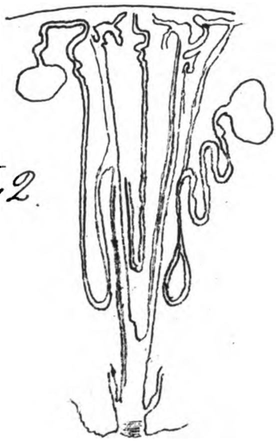
Vol. 1. Plate 5.

Fig 1.

Kidney of Rat.

Human.

Fig 2.



Human.

Fig 3.

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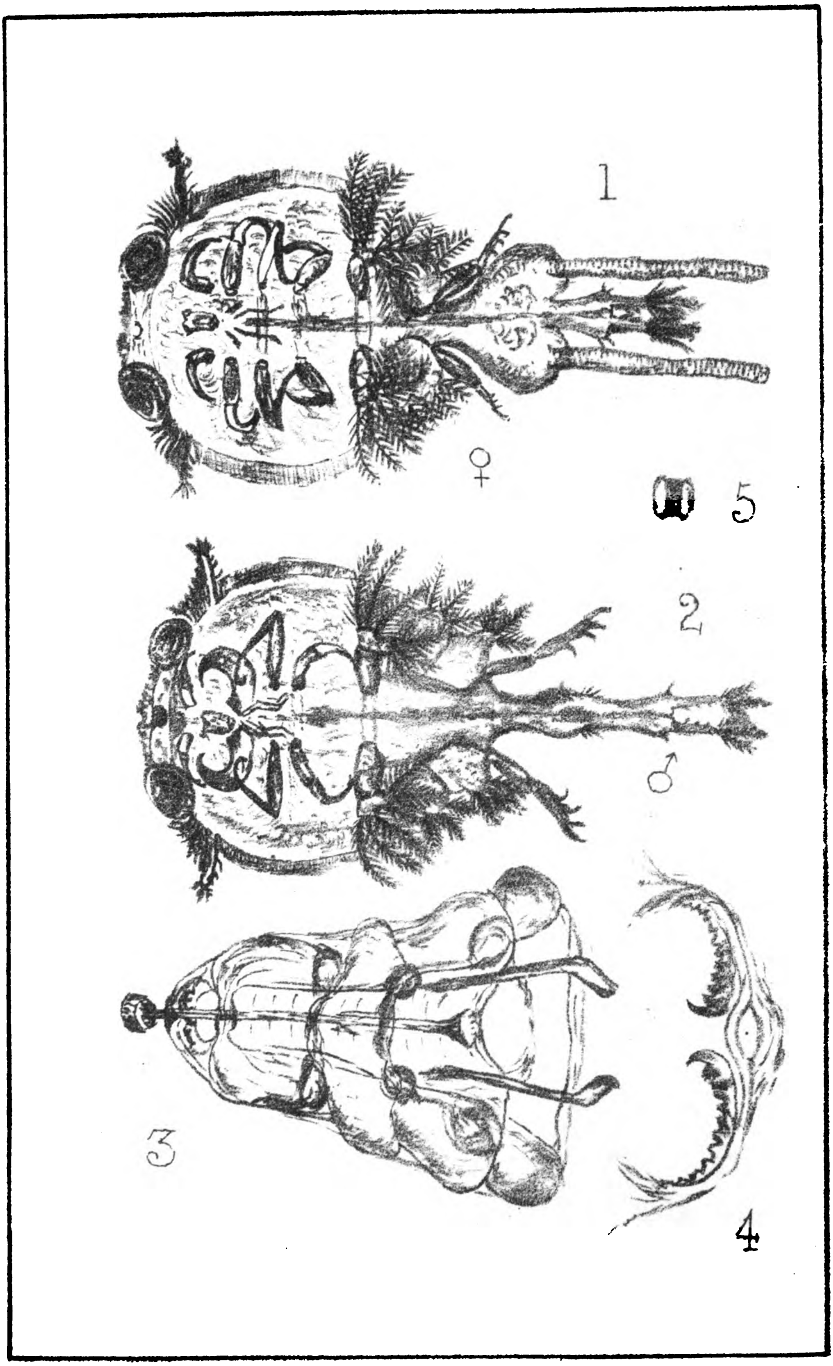

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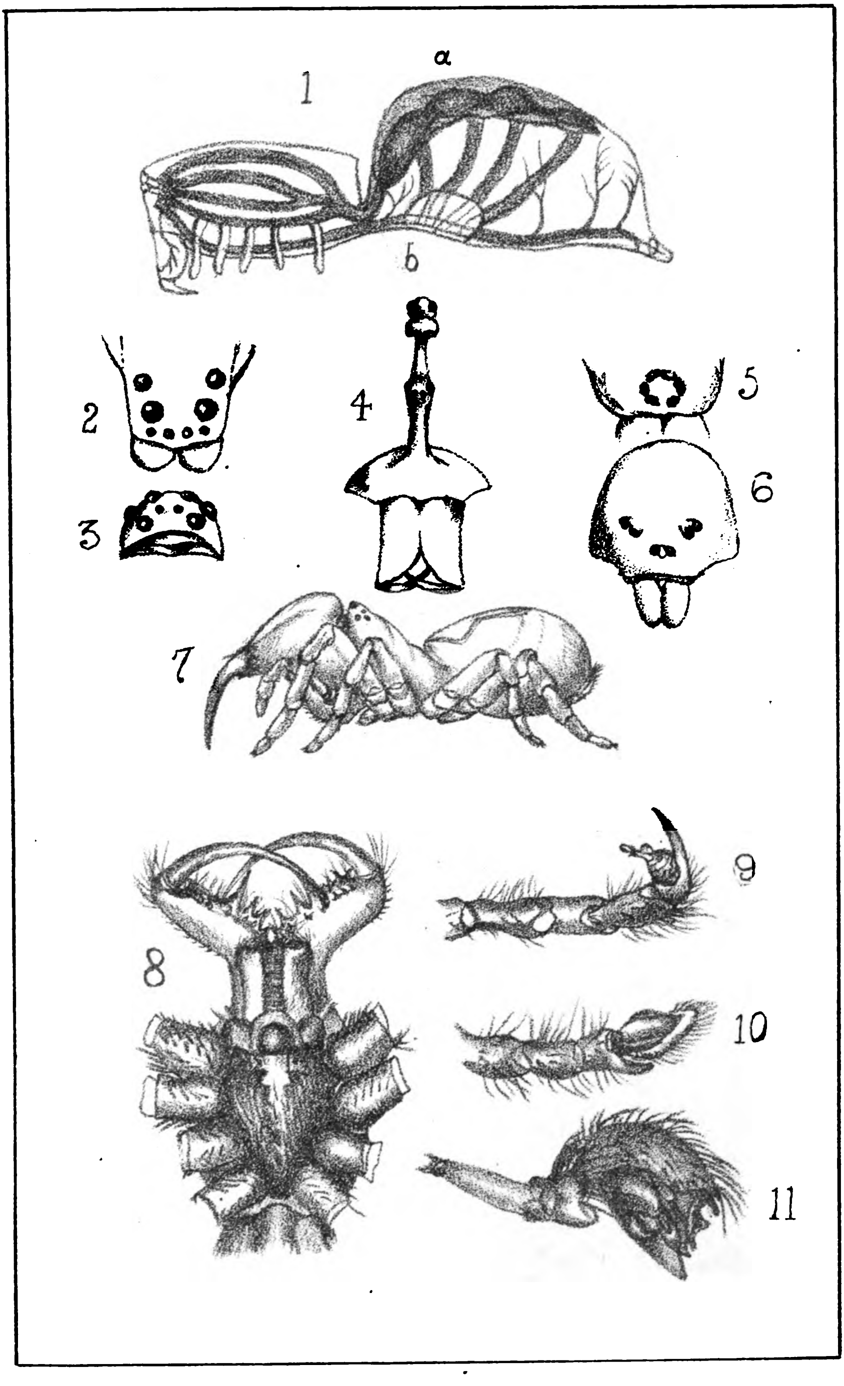

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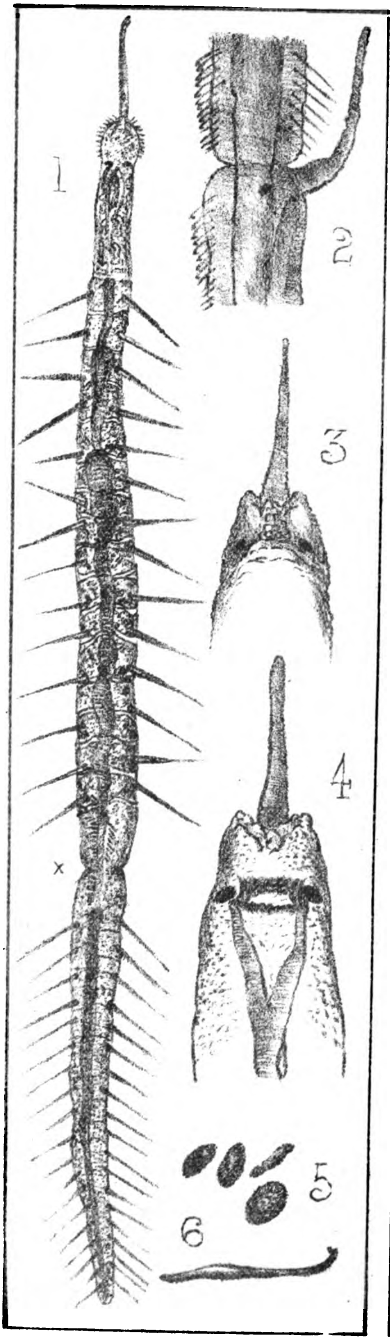

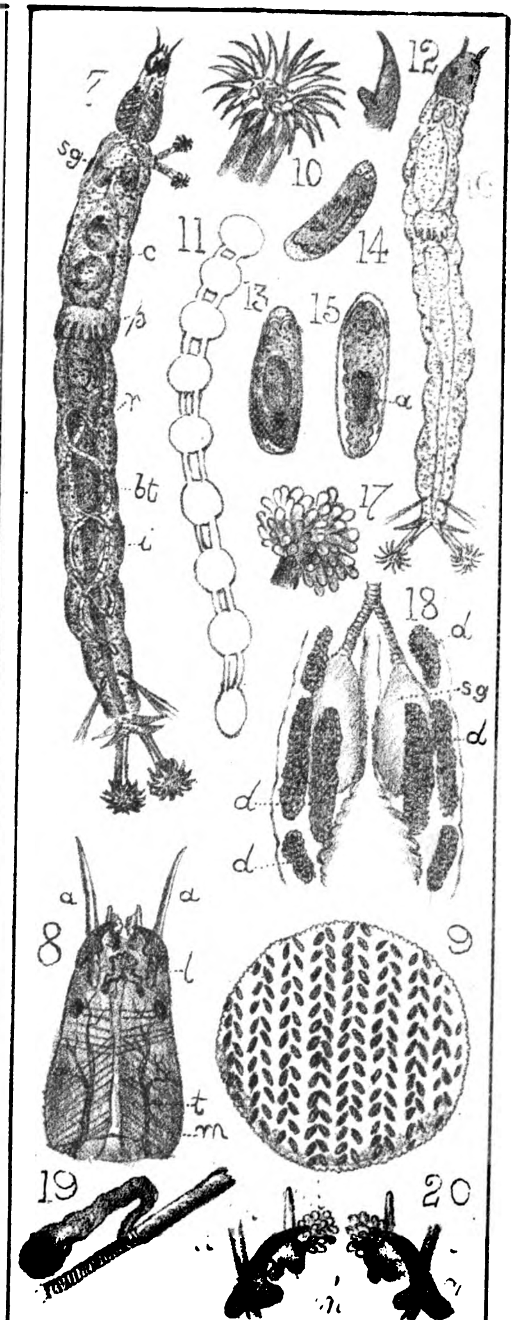

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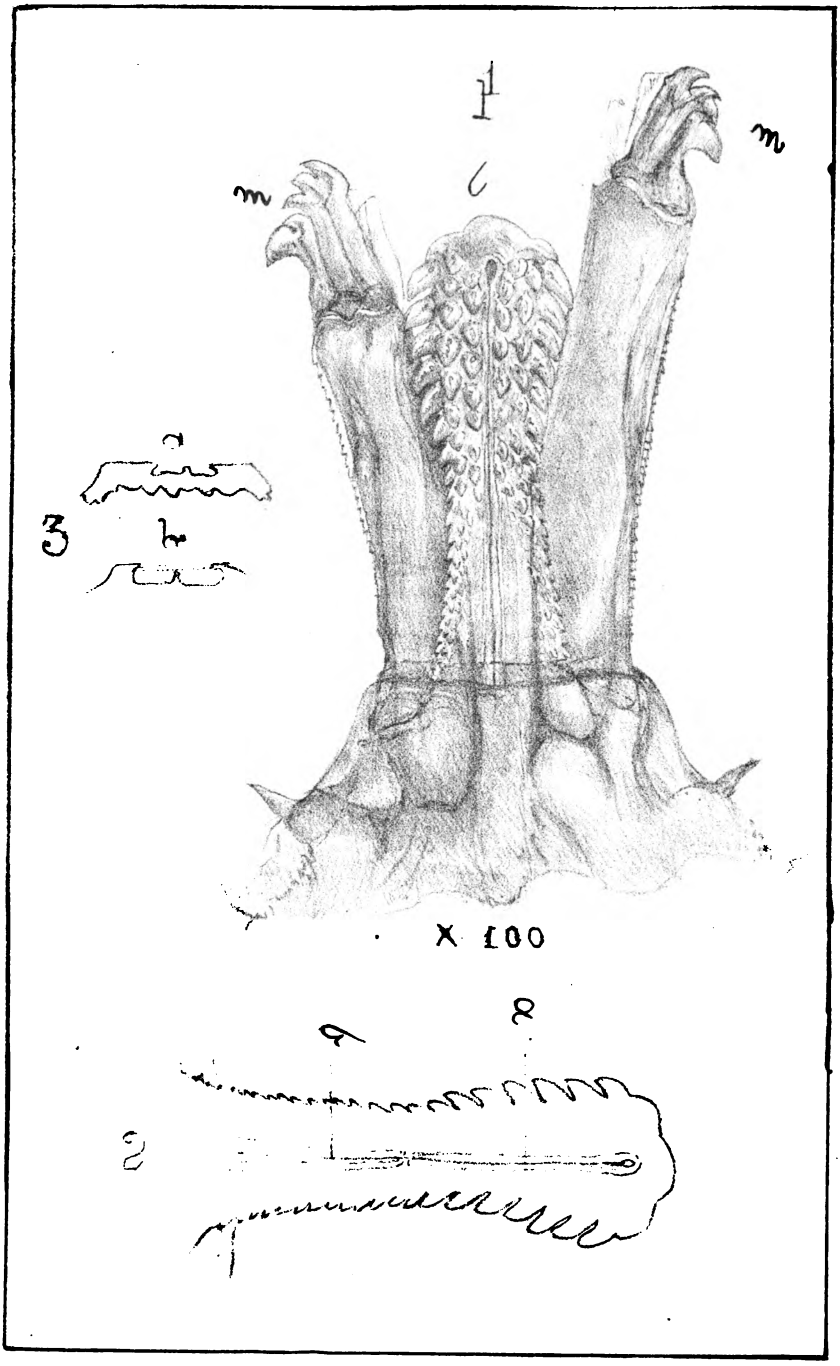

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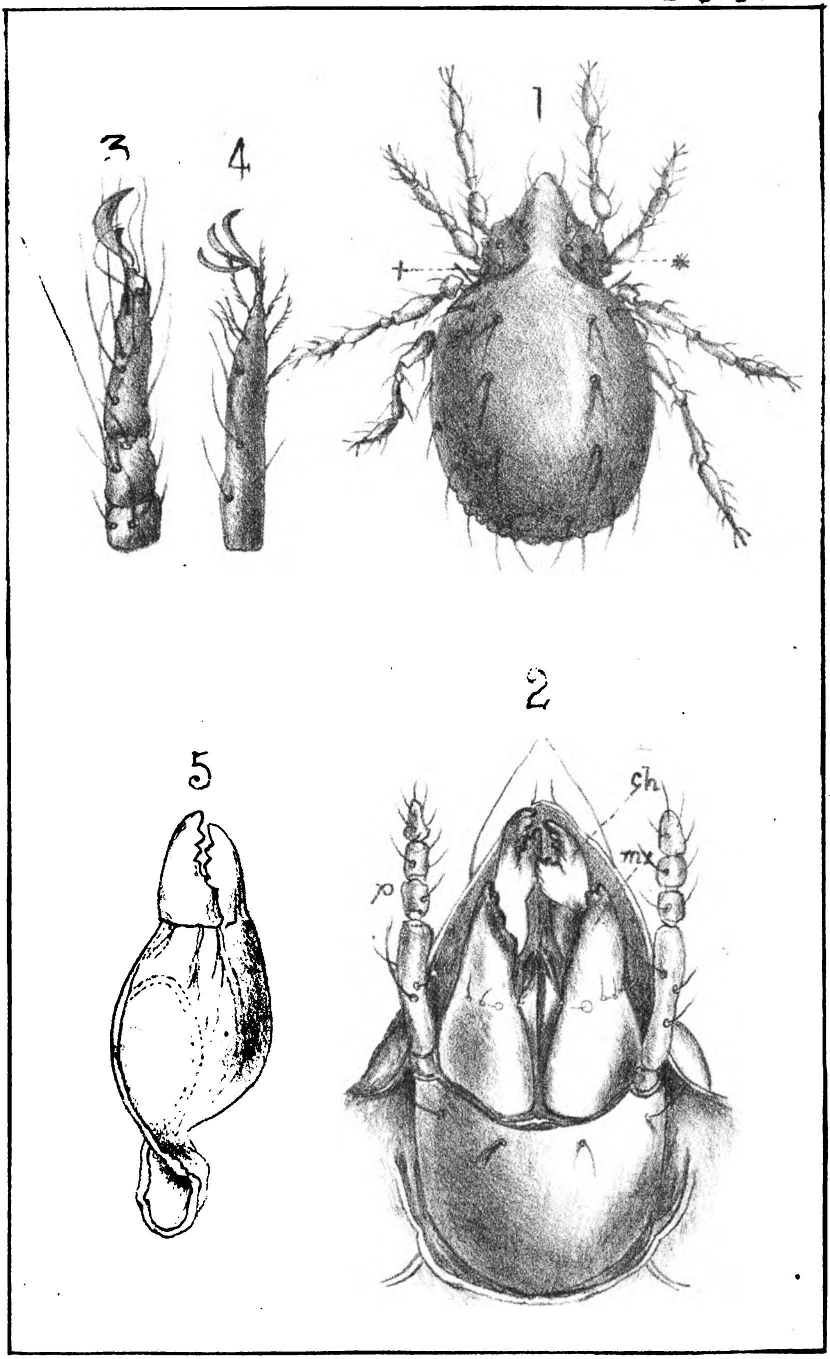

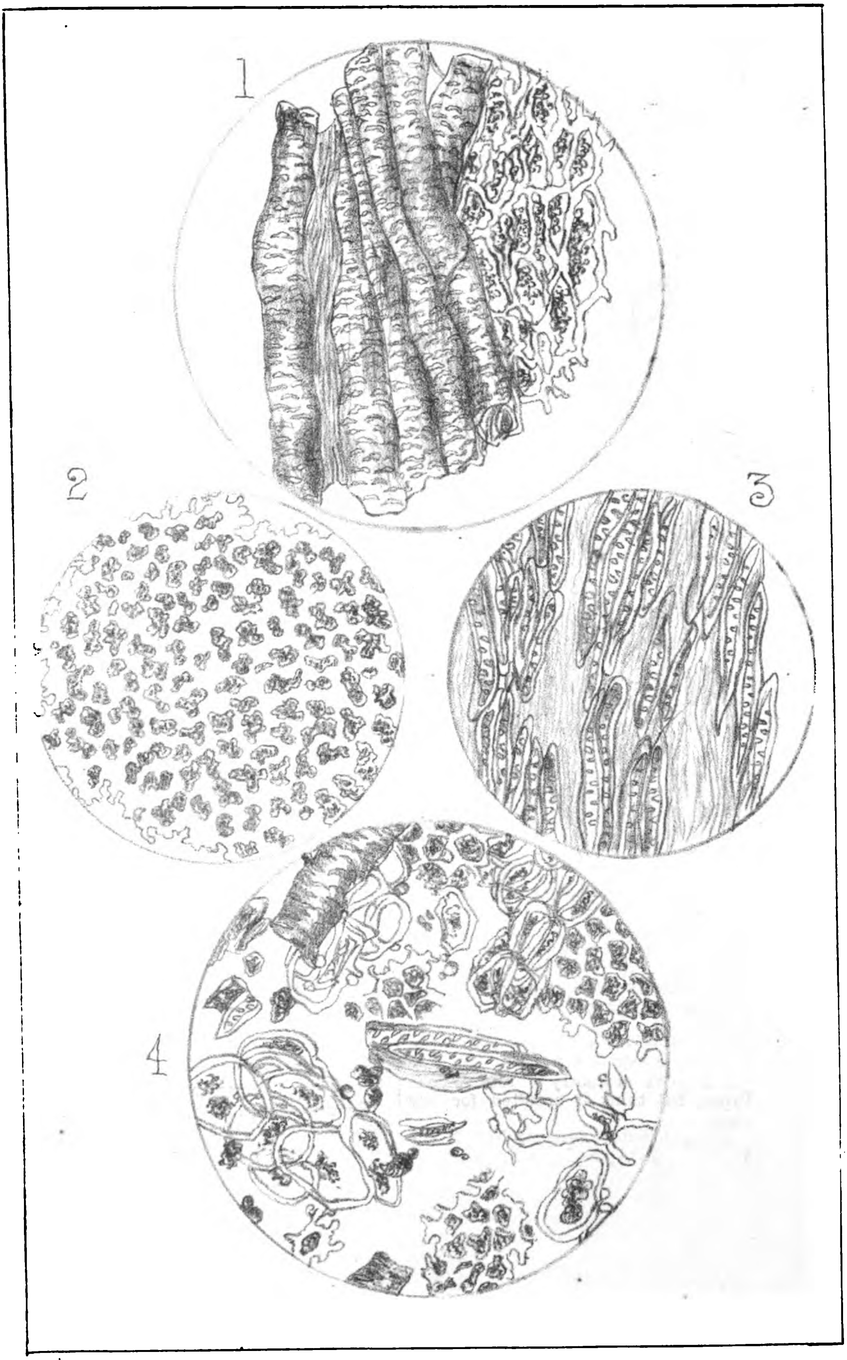
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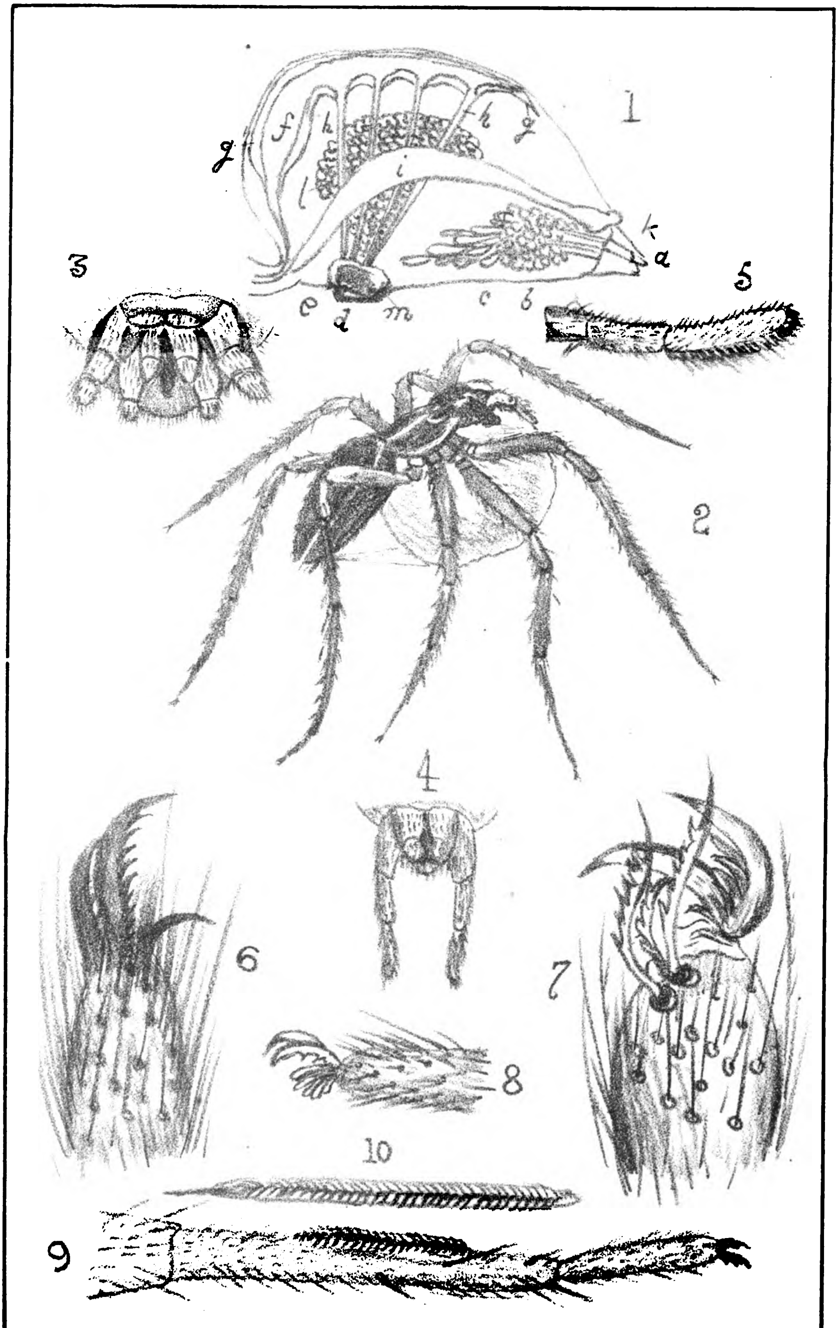
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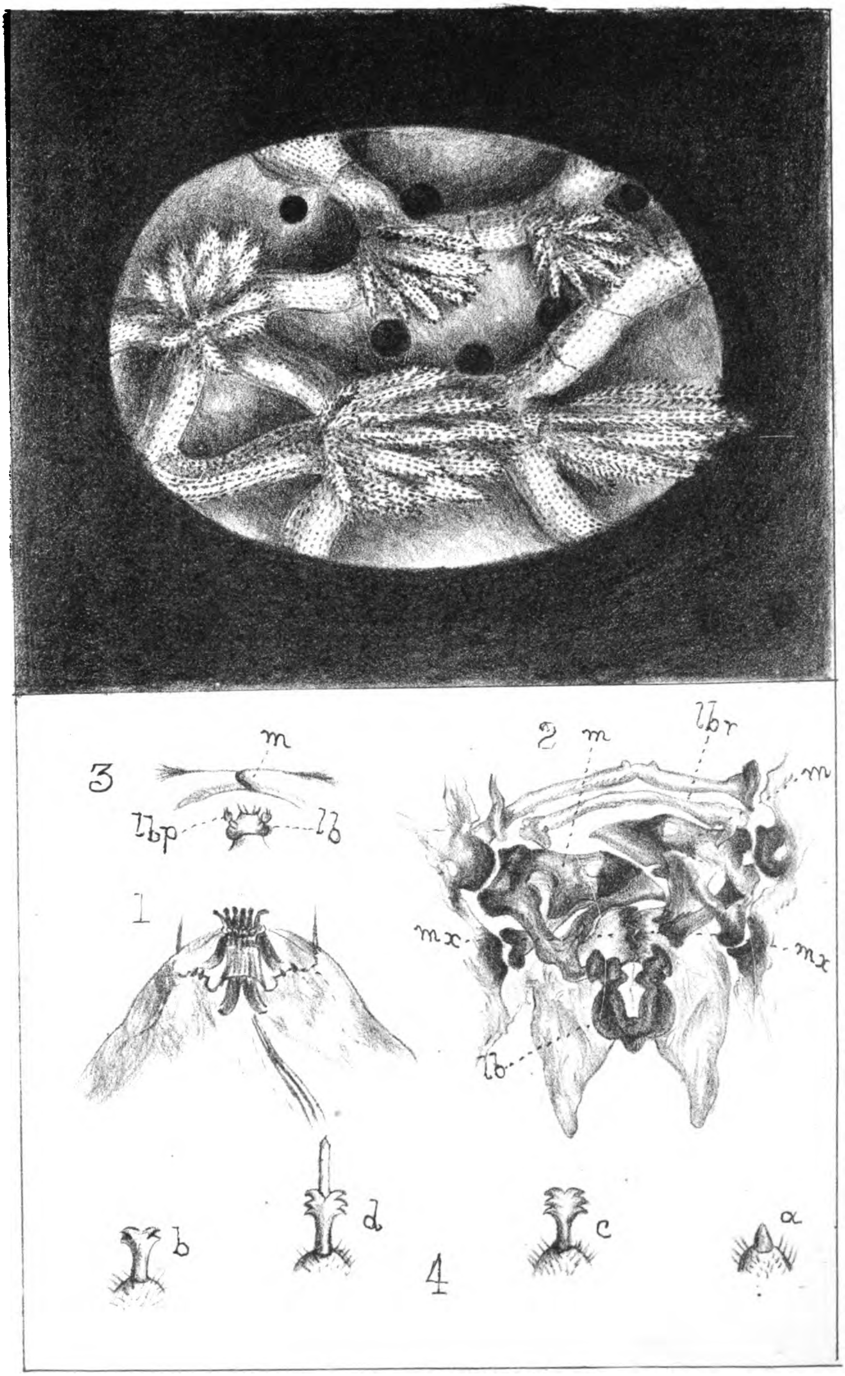
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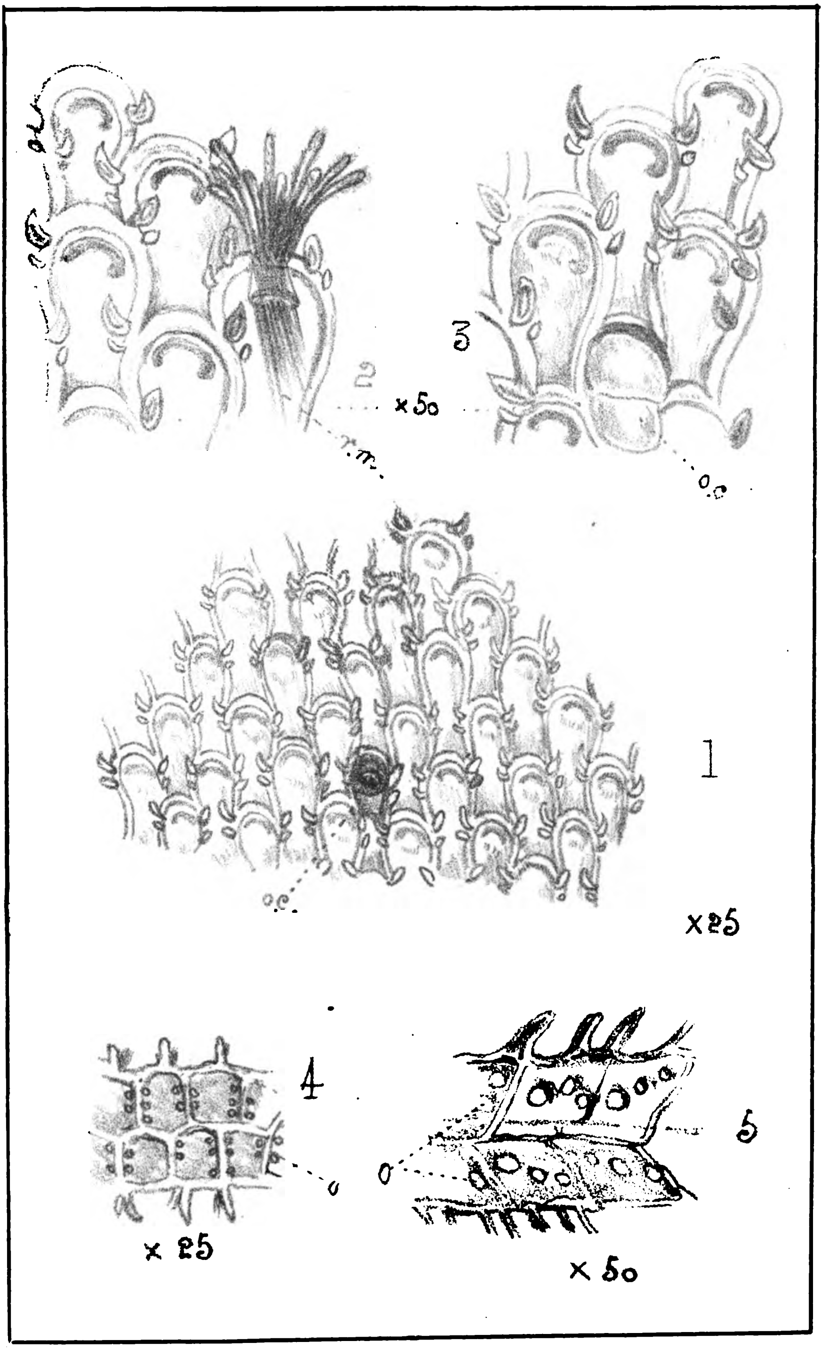
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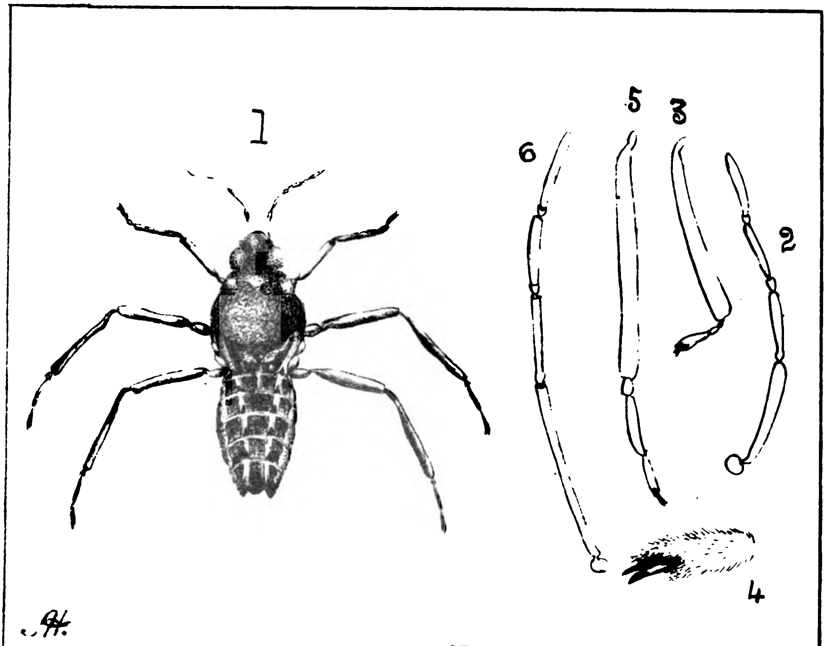
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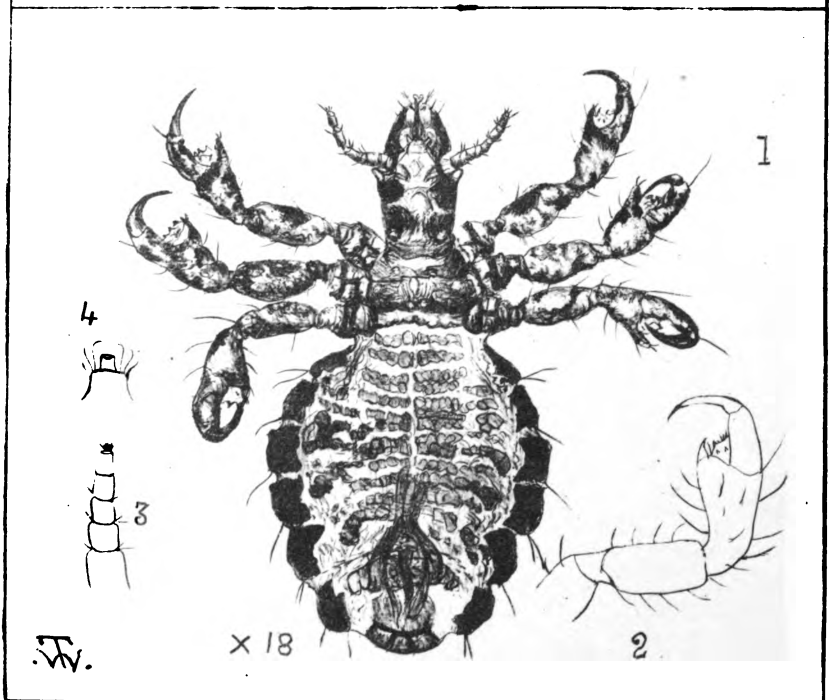
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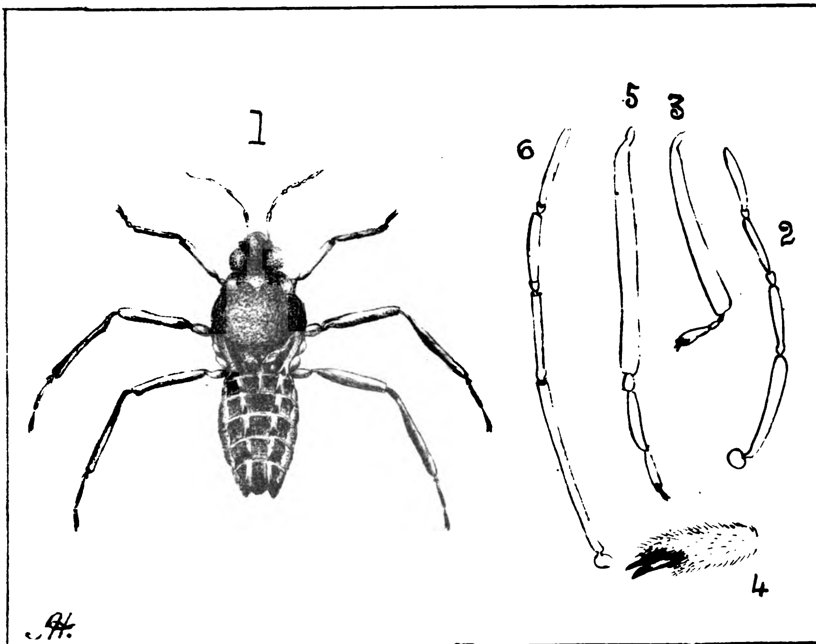
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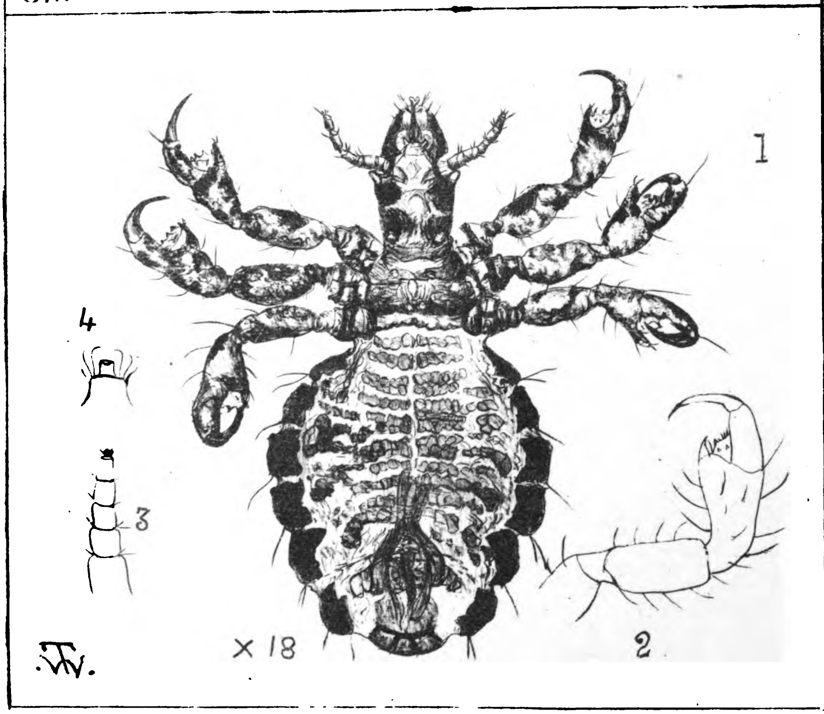
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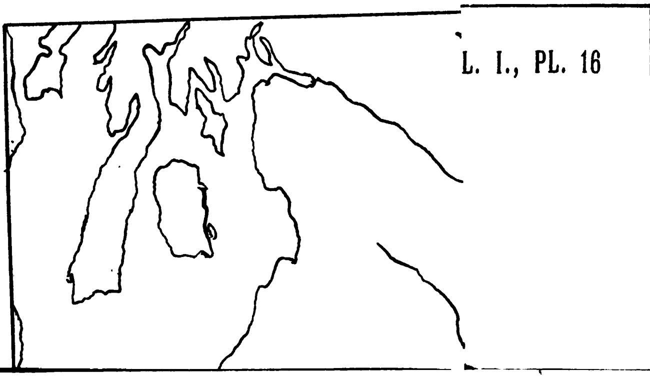
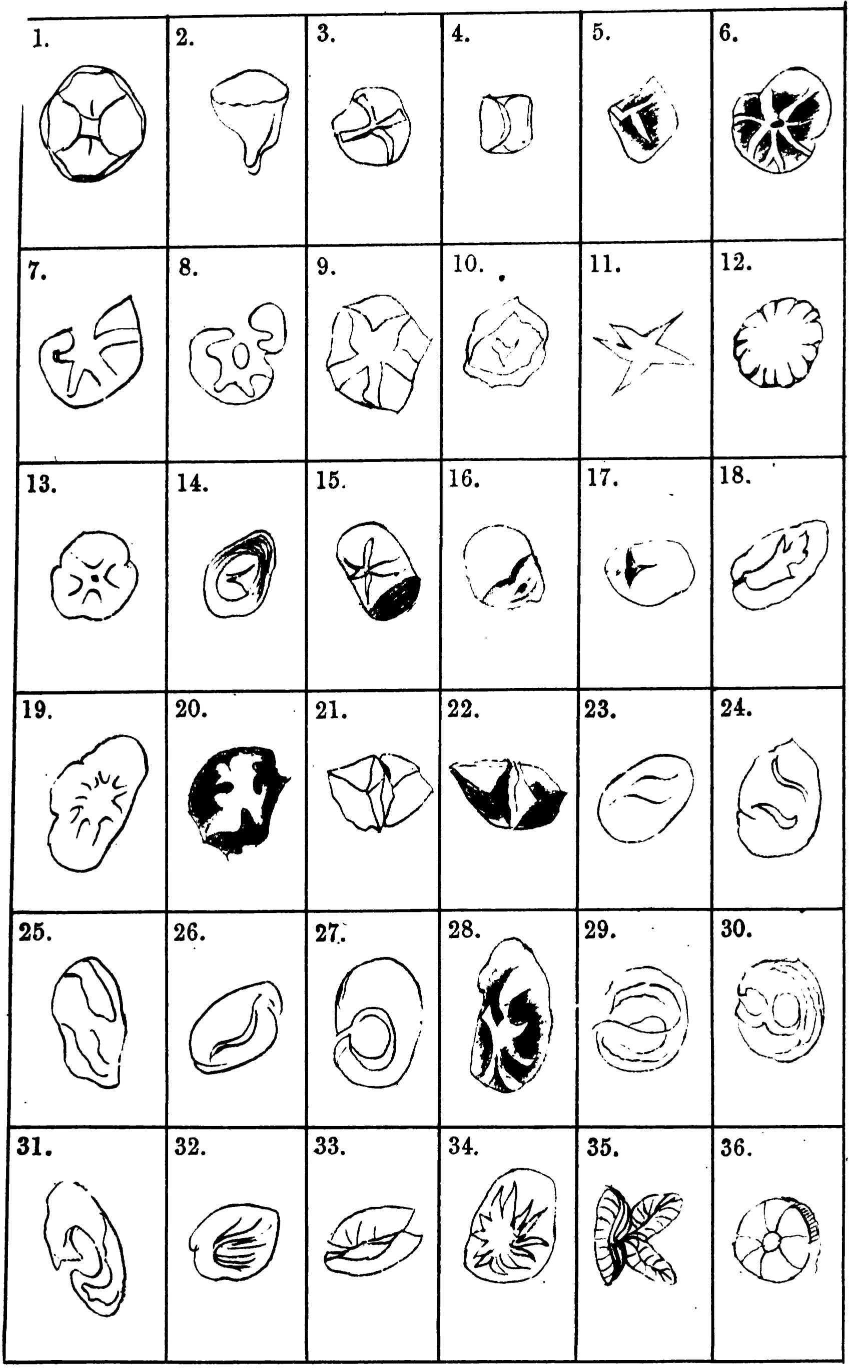
Map showing the Towns i[l]iety reside.

L. I., PL. 16

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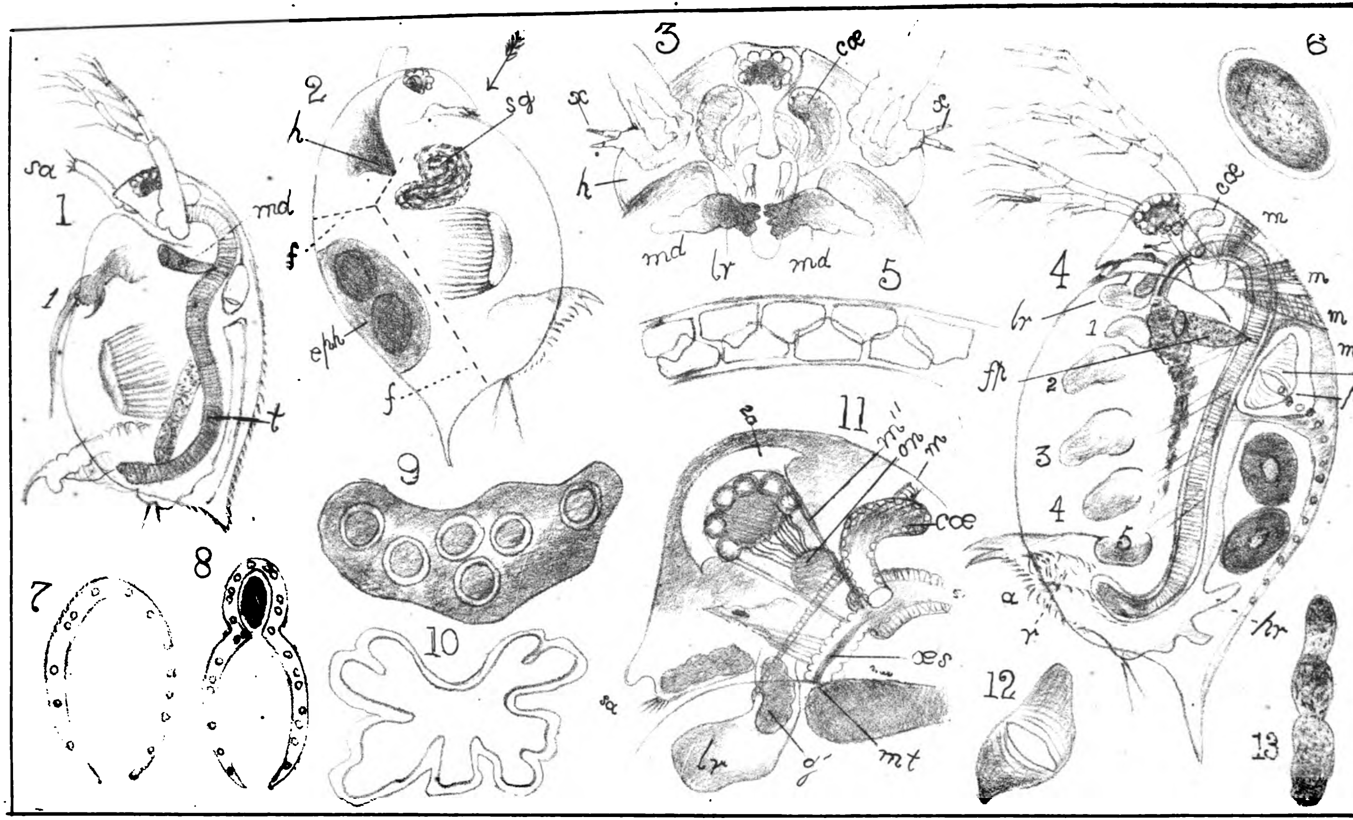

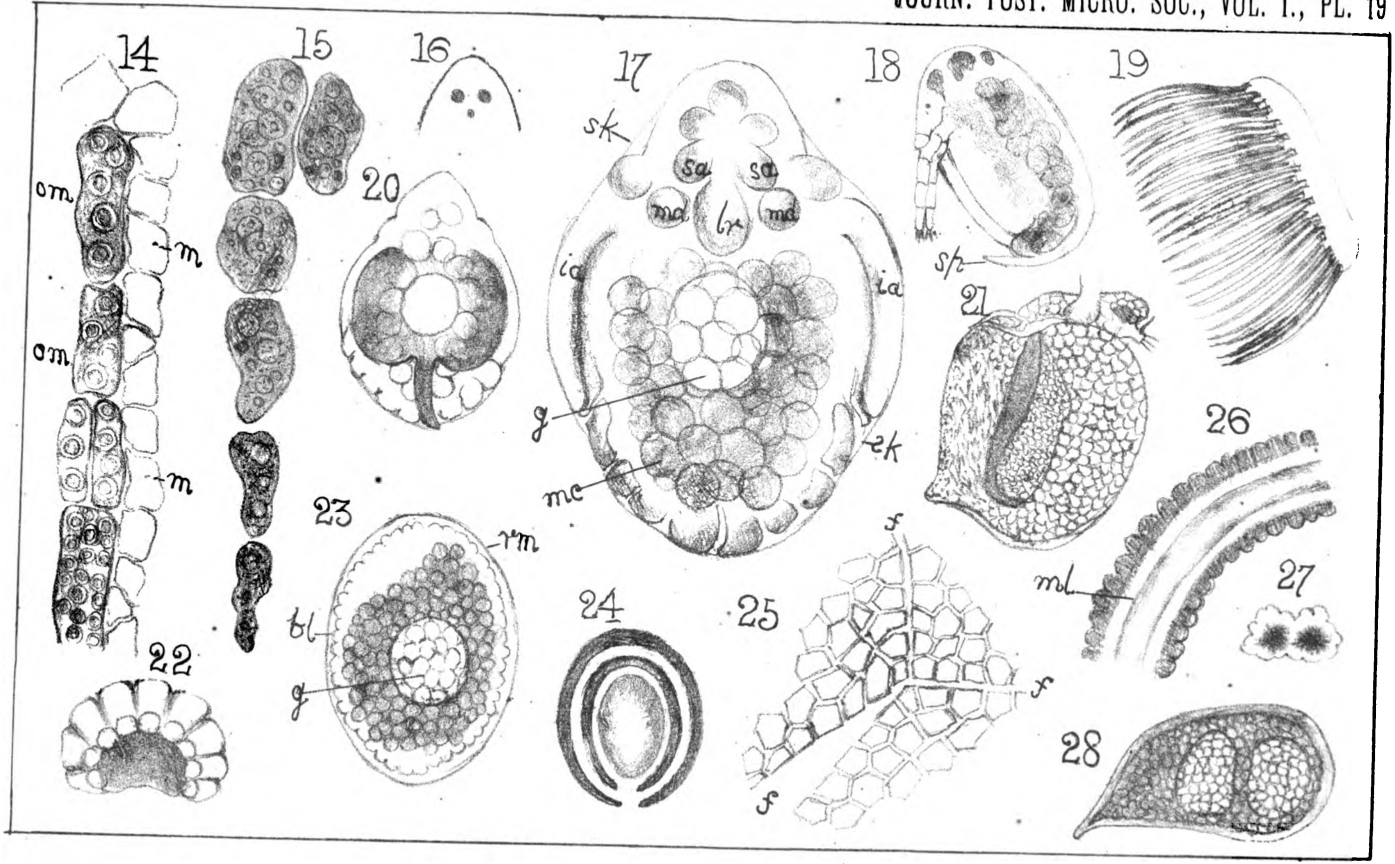
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No. 2. JUNE 24th. 1882.

The Journal of the Postal Microscopical Society,

A MISCELLANY OF

Natural and Microscopic Science,

PUBLISHED QUARTERLY.

"Knowledge is not given us to keep, but to impart: its worth is lost in concealment."

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The Annual Meeting of the Members and friends of the Society will be held on Thursday, October 5th, at the Holborn Restaurant, London, when the yearly Report will be presented, Officers chosen for the ensuing Session, and other business transacted. It is hoped that all Members will attend who can possibly make arrangements to do so, and that many will bring a friend with them. Tickets for the Dinner, price 4/- each, may be obtained from the Hon. Secretary, 1, Cambridge Place, Bath.

Immediately on the close of the present Session, all Slides now in circulation will be called in, with a view to replacing them by fresh ones. The Committee hope that all members will endeavour to be prepared with good *Slides* for re-filling the Boxes, and useful explanatory *Notes* to accompany them. In order to give greater facilities for good *Drawings*, it is proposed to make the Note-Books in future of a larger size, and suitable drawing-paper may always be had from the Hon. Secretary.

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No. 4. DECEMBER. 1882.

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